PLANTERS' RECORD

VOL. XXXIX

A quarterly paper devoted to the sugar interests of Hawaii, and issued by the Experiment Station for circulation among the plantations of the Hawaiian Sugar Planters' Association.

JANUARY TO DECEMBER

THE HAWAIIAN PLANTERS' RECORD

VOL. XXXIX

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THE HAWAIIAN PLANTERS' RECORD

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Another Step in Cane Breeding

A development in sugar cane breeding is that of using cane tassels in mass formation. The arrangement is shown on the cover of this issue. The object is to increase the chances of obtaining combinations that may hold rich possibilities of producing outstanding canes. Under this type of mass pollination we suffer a loss in the pedigree of the new canes, because the male parent remains unidentified among the hundreds of cane varieties brought together in this sugar cane melting pot.

However, we must sacrifice either the pedigree or the offspring itself because it is beyond the realm of practicability to cross, under isolation from contaminating pollen, as many matings as are thus given an opportunity to be realized.

To illustrate, if the hundreds of cane varieties shown under mass pollination in the picture were each mated separately with each of the rest we should need to arrange for over 100,000 such matings.

In the past we have found it practicable each year to bring about approximately 500 separate crossings, or trial marriages, as they call them at the Java station. Such crosses between selected parents are of course to be continued.

But we might, by use of the older system alone, defer for years—or scores of years—sugar cane combinations of exceptional interest and commercial value that may already have come about in our first mass pollinations.

The Genetics Department is putting this new development into practice following conferences on the part of A. J. Mangelsdorf during the past summer with geneticists on the mainland, where the idea is being employed for other crops.

Mass pollination of this type with sugar cane is dependent upon the sulphurous-phosphoric acid method of preserving cane tassels in a fresh and functioning form. It is a scheme originated at this Experiment Station through the researches of Verret, Das, and others.

It is of interest to speculate upon the millions upon millions of possible combinations when we contemplate crossing hundreds of cane varieties, each male with 40 or more chromosomes, each female with 40 or more chromosomes.

On just a few square feet of ground in a coconut grove at Kailua, Oahu, there have been brought together the sugar cane blood lines from India, China, Australia, Java, New Guinea, and islands of the South Seas—in a genetical orgy such as the genus *Saccharum* has never known before.

In This Issue:

Irrigation:

An interesting development in irrigation is described as the flume system or long-line herring-bone. This contribution to sugar cane culture on the part of Mr. H. W. Baldwin promises to be one of definite importance. The plan as described, or some of the modifications of it that are sure to follow, are likely to find a place in Hawaiian irrigation, for the scheme in principal has the advantage of doing away with many level ditches with their costly seepage losses, and presents a semi-automatic way of distributing water at a great reduction in labor.

The Hand Refractometer:

The hand refractometer and juice punch are described as a kit suitable for obtaining a rapid and relatively accurate measure of sucrose content in growing cane.

Fundamental studies on the sampling error in a field of cane are presented to show the degree of accuracy which may be expected from this kit.

The practical applications of the kit to plantation operations are pointed out. It is of value as a means of measuring ripening of fields soon to be harvested, profitable height of topping in the harvesting field, and finally as a means of studying the rate of sugar storage in new varieties.

A description is given of the use of this kit in Formosa.

Cane Growth:

Comparisons in the cane yields are often complicated on account of the two variables, one that of soil, the other that of climate. With the intent of noting the effect of climatic differences alone, a little study was undertaken using large concrete tubs filled with the same soil. Some of the tubs were placed at Makiki, others in the upper reaches of Manoa valley. Two varieties of cane were used in both places, P.O.J. 2878 and P.O.J. 36.

We all know, of course, that the climate of the lowlands is superior for cane growth to that under cloud banks in the uplands. Here, however, we have a quantitative measure of this difference, undisturbed by the factor of soil variation. The study is another small step in building up our basic information on the sugar cane plant, and its environmental influences.

Fertilizer:

Upon occasion the fertilizer programs of different plantations have been published. This subject is now brought up to date. The same plan as used before of depicting a fertilizer program has been followed. It puts before one in clear compact form: the kind of fertilizers; the amount of fertilizer; the composition of fertilizers into percentages of nitrogen, phosphate, and potash; and the pounds per acre of each of these ingredients applied at each application. The time of each application is also shown. Anyone not familiar with the scheme of presentation needs only to refer to the key on page 33.

Flume System of Irrigation*

(LONG-LINE "HERRING-BONE")

By H. W. Baldwin

Last year at this time we presented a preliminary report of a new adaptation of the long-line herring-bone or "Flume System" of irrigation being carried on by Maui Agricultural Company, Ltd. The system has given such gratifying results during the intervening months that we are presenting herein the complete performance record to date.

The flume system in this experiment consists of 29.7 acres with lines averaging 217 feet in length with a grade of 3 per cent. This is a very porous soil and has always been a heavy consumer of water. The 3 per cent grade from all appearances is about right for this type of soil. All portions of the lines seem to have had sufficient water, and that, without the need of opala in the lines. The cane appears to be every bit as good as that in the check plot which consumed 54 per cent more water.

All water used was measured by the engineering department by means of concrete Parshall flumes with Stevens water stage registers.

The size of flumes used in this experiment was 6″x 12″, i.e., 1″x 12″ floor with 1″x 6″ sides. In our paper last year we endeavored to show by means of cost curves, etc., that a flume of twice the capacity even at double the cost would be more economical. This point is again brought out in the table of "Cost of Flume System per Acre" found herein. For example: Assuming that the system will be used for at least four crops and that there will be 40 irrigation rounds per crop, or a total of 160 rounds, and that the contract irrigators will be on approximately a $2.50 per day basis ($2.00 for wages and $.50 for overhead) instead of $1.00 per day as shown in the table, the total cost of the 160 rounds with the three sizes of flume listed will compare as follows:

		$1.00 Basis	$2.50 Basis
6″x 6″ Flume	160 Rounds	$40.00 per Acre	$100.00 per Acre
6″x 12″ "	160 "	20.00 " "	50.00 " "
10″x 12″ "	160 "	10.00 " "	25.00 " "

It is obvious that the largest size flume is the most economical, as the saving in labor cost more than offsets the extra cost of the flume.

In accordance with these findings we have this year planted 115 acres to the flume system, using 10″x 12″ redwood flumes, instead of 6″x 12″, thereby adding four inches to the sides, which doubled the capacity and increased the cost by only one-third.

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* Presented at the Thirteenth Annual Meeting of the Association of Hawaiian Sugar Technologists, Honolulu, 1934.

There have been thirteen rounds of water applied to date and the best performance so far is 17 acres per man per day. The last few rounds gave the following results:

Round	Acres per Man	Acre Inches per Acre	
9	17.08	2.98	
10	13.52	3.88	(Shortage of water accounts for less acres per man)
11	12.10	4.55	"
12	16.5	3.51	
13	15.7	3.70	(Estimated)

So far we have confined our use of the flume system to the steeper parts of the fields having a slope of 5 per cent and over, where other long-line systems are either unsatisfactory or impossible. But with the increased use of this system we are beginning to realize that it can be so planned as to reduce the use of straight ditches and costly water gates and numerous level ditches with the attendant seepage losses. We have become accustomed to ignore level-ditch seepage losses believing them to be unpreventable. It is frequently stated that this seepage water is not lost but benefits the cane, citing in support of this contention the fact that the cane bordering level ditches has a better growth than that farther away from the ditch. But isn't it just possible that this growth is due to the larger feeding area available for the roots, and to the absence of vegetation in the ditches to absorb the moisture? At any rate, to our knowledge, not much, if any, study has been given to level-ditch seepage losses; but now that it is dawning upon us that these losses can be eliminated by the use of flumes it becomes important to find out if the losses are great enough to justify the use of flumes on the flatter lands.

To this end we solicited the aid of J. H. Hofmann, of the engineering staff, and he has made a careful study of level-ditch seepage losses on various fields of both young and old plant cane and upon ratoon fields of various ages. Small, portable, galvanized Parshall flumes were installed in the ditches, one at the head and one at the end of the ditch. Water was allowed to flow through the ditch with all outlets closed for a period of over four hours, ten-minute readings were taken of the gauge heights, and the total water flowing through the respective flumes was then calculated. The difference between the two totals gave the loss, and this divided by the length of ditch gave the loss in cubic feet per foot of ditch per minute. Following are the results secured on this very porous soil:

RESULTS OF LEVEL-DITCH SEEPAGE MEASUREMENTS

Date	Field	Age of Ditch	Length Feet	Time Hrs.	Time Min.	Loss in Cubic Feet per Foot per Minute
9/ 4/34	4	4 months	859	4	9	.033
9/ 7/34	61	15 "	594	4	9	.042
9/ 7/34	6	2 years	504	4	30	.028
9/11/34	7	2 1/4 "	355	4	5	.055
9/13/34	5	4 "	420	4	7	.033
9/12/34	7	7 "	661	4	55	.051

Having determined the seepage loss in cubic feet per foot of ditch per minute, Mr. Hofmann next proceeded to determine what the loss in acre inches amounted

to during one irrigation round on an area of 95.36 acres, in Field 4. By means of stop watches the number of minutes that water flowed in each foot of level ditch during the complete round was recorded. Then using the factor of .033 cubic feet per foot per minute pertaining to Field 4, the loss was determined to be 41.00 acre inches. This would be sufficient to irrigate 13.65 acres to a depth of 3 inches.

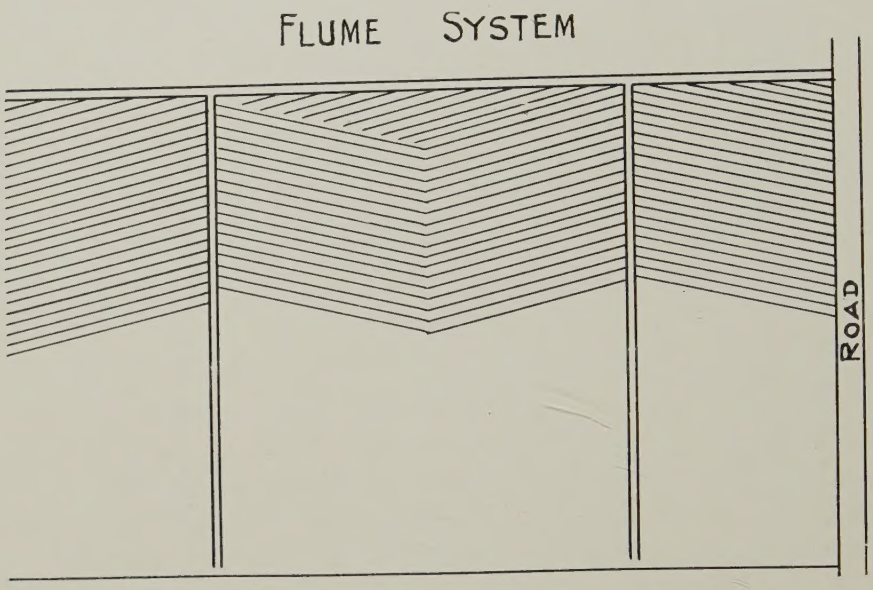

Fig. 1. Showing flume system on a 10-acre field with 15 per cent slope. The layout would be the same on any slope and is entirely satisfactory on maximum slopes. Note uniform length of lines, also absence of level ditches.

Costs:

680-foot flume (10"x 12")	$170.00
16 watercourse boxes for short lines at head	5.75
2 single water gates	7.00
Cost per 10 acres	$182.75
Cost per acre	$ 18.27

Performance:

Best performance to date, 17 acres per man per day. Last rounds (12th and 14th) 16.9 acres per man per day.

This diagram represents ideal conditions which of course seldom exist in the field and the low cost for the flume system as shown in Fig. 1, could not quite be attained except under such ideal conditions. However, these cost figures serve to bring out the point that the cost of the flume system is not as prohibitive as is generally supposed. Considering the fact that straight ditch gates and level ditches are largely eliminated by the use of flumes, it is seen that there is not much difference in cost between this system and other long-line systems in extensive use.

In light of the foregoing facts it would seem that the matter of using the flume system on loose, porous soils for the purpose of eliminating level-ditch seepage

losses deserves deep consideration. In conclusion, we feel that the flume system has now proven itself to be highly efficient as to economy in both labor and water.

FLUME SYSTEM VS. CONTOUR SYSTEM
FIELD 61 PERFORMANCE RECORD

FLUME SYSTEM 29.7 Acres (6" x 12" flume)					CONTOUR SYSTEM 21.55 Acres			
Date	Men	Acre Inches per Acre	Acres per Man	Round No.	Acre Inches per Acre	Acres per Man	Men	Date
July 13	8	3.88	2.97	1	6.30	.47	45	July 19
" 17	14	3.76	2.15	2	3.45	1.43	15	" 24
" 24	6	5.32	4.95	3	3.75	1.35	16	Aug. 2
Aug. 1	4	4.57	7.45	4	3.41	1.12	17½	" 10
" 9	4	4.39	7.45	5	3.06	1.54	14	" 17
" 17	3¼	3.16	9.15	6	5.85	.72	29½	" 31
" 30	3¼	4.67	9.15	7	5.87	.68	31¾	Sept. 12
Sept. 11	4	5.32	7.42	8	5.63	.54	33½	" 23
" 22	3.3	5.49	9.02	9	5.60	.86	25	Oct. 5
Oct. 4	3.5	3.88	8.50	10	6.58	.74	30	" 17
" 16	3.4	6.17	8.70	11	6.57	.68	31½	" 31
" 28	4.8	3.95	6.18	12	6.36	.63	34	Nov. 17
Nov. 15	5.6	3.83	5.30	13	7.83	.88	24.3	Dec. 11
Dec. 18	6.2	5.41	4.80	14	5.00	1.27	17	" 20
Jan. 8	6	5.80	4.95	15	6.21	1.21	17.7	Jan. 5
" 18	5.4	4.66	5.50	16	5.31	1.54	14	" 20
" 31	5	2.92	5.94	17	7.13	1.92	11.2	Feb. 7
Feb. 12	4½	4.17	6.60	18	6.43	2.69	8	" 18
" 23	3¼	3.75	9.14	19	6.77	2.69	8	March 2
March 7	3¼	4.62	9.14	20	7.70	2.87	7½	" 13
" 16	3	4.35	9.90	21	10.99	2.87	7½	" 23
" 26	3	4.90	9.90	22	6.57	3.59	6	April 1
April 3	2.5	3.52	11.90	23	7.15	3.04	6½	" 17
" 19	3.5	4.88	8.50	24	9.27	2.27	9½	May 1
May 4	3.5	5.23	8.50	25	11.20	2.15	10	" 20
" 23	5.0	6.43	5.93	26	11.20	2.80	7½	June 1
June 4	4	7.32	7.40	27	10.38	2.80	7½	" 13
" 15	4¼	6.65	7.00	28	11.11	2.80	7½	" 22
" 25	4¼	7.11	7.00	29	14.60	2.53	8½	July 7
July 6	4	7.59	7.42	30	12.29	2.53	8½	" 18
" 17	5½	7.12	5.41	31	12.40	2.69	8	" 30
" 29	5	8.09	5.94	32	18.85	1.79	12	Aug. 22
Aug. 9	5	7.63	5.94	33	15.84	2.22	9.7	Sept. 10
" 28	7	11.68	4.24	34	15.60	2.26	9.5	" 30
	160.2	182.22			282.26		548.65	

Total Acre Inches Applied per Acre to Date on Contour System..... 282.26
Total Acre Inches Applied per Acre to Date in Flume System..... 182.22

Amount Saved by Flume System..... 100.04
The Contour System Used 54.9 Per Cent More Water Than the Flume System.

Cost of Flumes: In comparing costs of different systems it is necessary to take into account the length of lines used. Obviously, a flume will serve more acres if the lines are 300 feet in length than if they are only 200 feet. For that reason we have tabulated flume costs according to various lengths of lines and also with different sizes of flumes in both northwest and redwood lumber. To enable one to determine the most economical size to use, the expected performance must also be taken into account. We have incorporated this in the cost table in accordance with our experience with the systems thus far.

COST OF FLUME SYSTEM PER ACRE
COMPLETE WITH FLUME GATES

Length of Lines	Lines per Acre	Lineal Feet Flume Per Acre	Size of Flumes		Cost per Acre: Dollars	Performance: Acres per Man Day	Labor Cost per Acre per Irrig. at $1 Day
			Side	Floor			
200 feet	48	108-132	6″	6″	NW 15-18 RW 17-21	4	$ .25
			6″	12″	NW 17-21 RW 20-25	8	.125
			10″	12″	NW 22-27 RW 26-32	15	.066
268 feet	36	81-99	6″	6″	NW 11-13 RW 13-16	4	.25
			6″	12″	NW 13-16 RW 15-18	8	.125
			10″	12″	NW 16-20 RW 20-24	15	.066
300 feet	32	72-88	6″	6″	NW 9-12 RW 11-14	4	.25
			6″	12″	NW 11-14 RW 13-16	8	.125
			10″	12″	NW 14-18 RW 17-22	15	.066

(Note: It will be observed that the performance per man day is shown as the same regardless of length of lines. We have assumed that the longer lines would be used only on tight soils and that the increased velocity of the water over that obtained in loose soils would compensate for the extra length of lines. This may be a wrong assumption, but, on the other hand, the performance may even be greater on the longer lines. We have no figures bearing on this point. However, a flume will carry 5 cubic feet more or less per second, depending on the grade. This will amount to about 50 acre-inches per ten hours. If the soil is such that as little as 2 inches per acre can be applied, 25 acres would be irrigated in ten hours, or with a 3-inch application 16.6 acres would be irrigated in ten hours, etc.)

Flattening bottom of single furrow for flume installation.

Flumes ready for installation.

Cane trash being installed under each gate in flume.

Placing flume.

Pulling up head lines to flume.

Flume gate ready for irrigation.

The flume in use.

Flume irrigation; note the herring-bone arrangement of furrows.

Applications of the Hand Refractometer in Sugar Cane Research

I. Fundamental Studies in Sampling Sugar Cane for Sucrose—C. G. Lennox.
   A. The stalk-to-stalk error in a population of sugar cane stalks.
   B. Correlation between Brix and per cent recoverable sucrose.
   C. Correlation between Brix of the lower, middle, and upper portions of the stalk with per cent recoverable sucrose from the whole stalk.
II. Basic Studies with the Hand Refractometer—U. K. Das.
III. Some Practical Uses for the "Punch Juice Sampler" and Hand Refractometer in the Cane Fields—C. G. Lennox.
   A. Comparative studies on seedlings.
   B. Preharvest juice sampling to determine relative ripeness of fields.
   C. An aid in determining the profitable height for topping the cane in the harvesting field.
IV. Use of "Punch Juice Sampler" and Hand Refractometer in Formosa —Y. Kutsunai.

I. Fundamental Studies in Sampling Sugar Cane for Sucrose

A. The Stalk-to-Stalk Error in a Population of Sugar Cane Stalks.

A crop of sugar cane growing on an area of ground is composed of a population of individual stalks which are all related in conformation and sucrose content but by no means identical. A stalk-to-stalk analysis will show differences in diameter, length, specific gravity, fibre, sucrose content, and many other qualities. These are all sufficiently different so one could not choose any one or few stalks and say that they are absolutely representative of the population. The only absolute measure is to take the entire population, but this being impossible, the next best thing is to take enough stalks to feel certain that the sample will be an approach to the true figure within a known range of error.

The purpose of this section of the paper is to examine the stalk-to-stalk variation in sucrose content of different populations of sugar cane and find a means of arriving at the closest estimate of the true figure for the entire population. To do this the standard procedure for obtaining the "probable error of a single observation" is used in connection with a formula used by F. E. Denny (3, p. 49) which calculates the number of individual observations needed to obtain a mean which will be within a desired range of error. The formula is as follows:

$$N = \left(\frac{3.2 \times \text{P.E.s.o.}}{\text{Expected Deviation}} \right)^2$$

N is the number of individuals needed to obtain a sample which will be representative of the entire population for a specified "expected deviation."

P.E.s.o. is the probable error calculated for each individual in the population and is obtained by making a number of individual stalk analyses.

Expected Deviation is the amount of error the investigator is willing to attach to his findings, i.e., a three per cent or six per cent or any other error which the case in point may seem to justify.

3.2 is the coefficient in the table of odds which is equivalent to odds of 30 : 1.

The following data will illustrate the use of the formula and also the stalk-to-stalk variation in sucrose content. The data are from mature stalks of cane 17 months old at harvest and grown on the Makiki plots. In each variety 10 mature stalks were chosen and each stalk crushed separately in a small mill which extracts from 50 to 60 per cent of the available juice. The juice from each stalk was analyzed in the routine manner for the total per cent recoverable sucrose.

Variety	Average per cent recoverable sucrose for 10 stalks	P.E.s.o. in per cent	By Denny's formula the *number* of *stalks* required to give the true per cent recoverable sucrose within the limits of an error of:	
			3 per cent	6 per cent
28-1234	15.0	2.7	8	2
27 C 556	11.8	4.0	18	5
26 C 189	13.0	5.5	35	9
H 109	13.2	7.3	61	15
25 C 28	11.4	10.3	120	30
28-916	8.0	16.3	300	76

These figures illustrate the necessity of finding the individual variation in a population before an attempt is made to select the number of individuals needed to give an adequate measure of the true mean for the whole.

The practical difficulties involved in using the whole length of stalk are evident when it is realized that in a field where the probable error of a single stalk was found to be 7.3 per cent it would necessitate cutting out 61 whole stalks to obtain a sucrose figure on which the odds were 30 : 1 that it will be within 3 per cent of the true mean for all the stalks in the neighborhood of the sampling station. Then if the conditions within the field are sufficiently variable as to require a number of sampling stations, say one for each 10 acres, we would find it necessary to remove 610 stalks from a 100-acre field every time a preharvest sample is taken. It is difficulties of this sort that have led sugar investigators to consider other means of finding the sucrose content of a field.

Reports from Java and Formosa tell of the use of a punch which extracts a few drops of juice from a stalk for a reading of total solids in solution (Brix) by the hand refractometer. This system allows for the sampling of many stalks with little or no injury to the crop of cane. Its reliability is based upon the assumption that Brix is a good measure of sucrose content.

B. Correlation Between Brix and Per Cent Recoverable Sucrose.

The first record of an effort to measure the correlation between Brix and per cent recoverable sugar at the Experiment Station was in 1917 when a correlation chart was constructed from the Brix and recoverable sucrose analyses of a population of seedlings. Since that time the coefficient or correlation factor for Brix

versus recoverable sucrose has been calculated for a number of other populations. These are summarized as follows:

Description of population	Coefficient of correlation factor	Probable error of coefficient of correlation factor
472 seedlings in Alexander plot of 1918 propagation	.925	±.004
576 seedlings in Makiki plot of 1917 propagation	.974	±.001
928 seedlings in Makiki plot of 1917 propagation	.954	±.002
1,028 seedlings in Makiki plot of 1927 propagation	.935	±.003
504 stools of H 109 variety in Field 21, Waipio	.875	±.006

The high degree of correlation which exists between Brix and recoverable sucrose, as shown by the calculated coefficient, would indicate that Brix can be used with assurance as a measure of sucrose content where a high degree of accuracy is not needed or possible to obtain. In other words a more accurate figure for the sucrose content of a field can be obtained by increasing the number

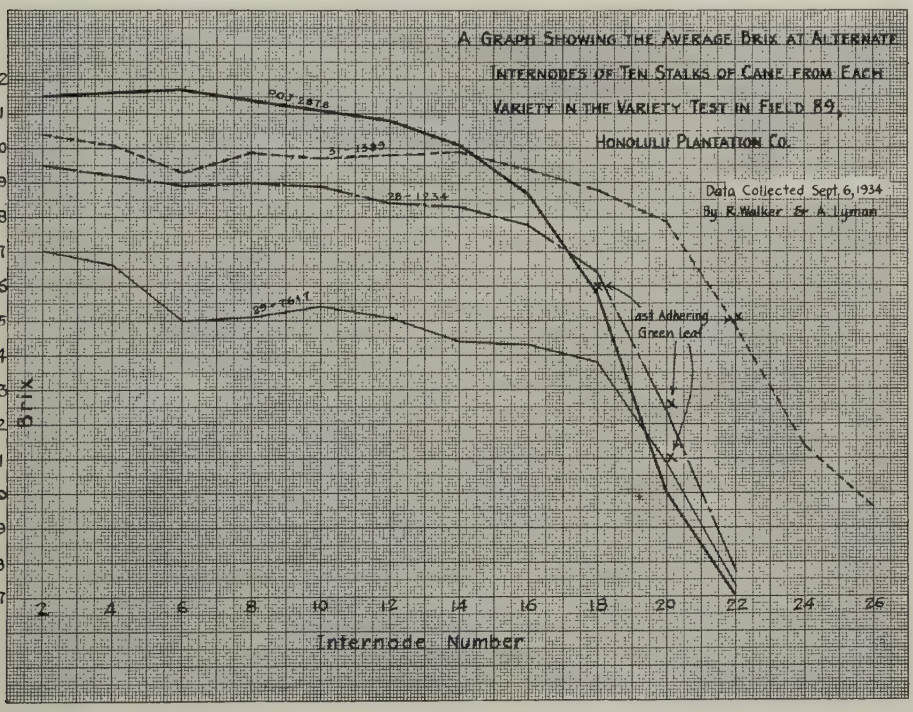

Fig. 1. The Brix remains relatively constant in the mature dry-leaf portion of the stalk 6 to 8 internodes below the last adhering green leaf, and becomes progressively lower as the immature green-leaf portion is approached and entered.

of stalks sampled and thereby decreasing the larger sampling error, and using Brix as a measure of the recoverable sucrose in this juice, rather than taking a fewer number of stalks on which a complete analysis for sucrose content can be made for the sake of reducing the relatively small error of Brix as a true measure of sucrose.

C. Correlation Between Brix of the Lower, Middle, and Upper Portions of the Stalk with Per Cent Recoverable Sucrose from the Whole Stalk.

At what point in a stalk of cane will a sample of juice be most representative of the whole stalk? U. K. Das (2, pp. 63-68) has shown that there is little change in the Brix of the internodes in the dry-leaf portion of the stalk. Similar studies conducted on seedlings (Fig. 1) show that there is little change in Brix in the internodes between the sixth or eighth internode below the last adhering green leaf. It would therefore be reasonable to assume that the juice from the middle portion of the stalk would be most representative of the whole.

In 1927 a study was conducted with 1,028 seedlings growing in the Makiki plots in which a composite juice sample was drawn from the lower internodes of each stalk in a seedling stool, one from the internodes in the middle section of stalks, and one from the upper internodes in the region of the green leaves. The samples were taken by cutting a small section from the stalk and squeezing out a few drops of juice from each section with pliers. A Brix reading was made with

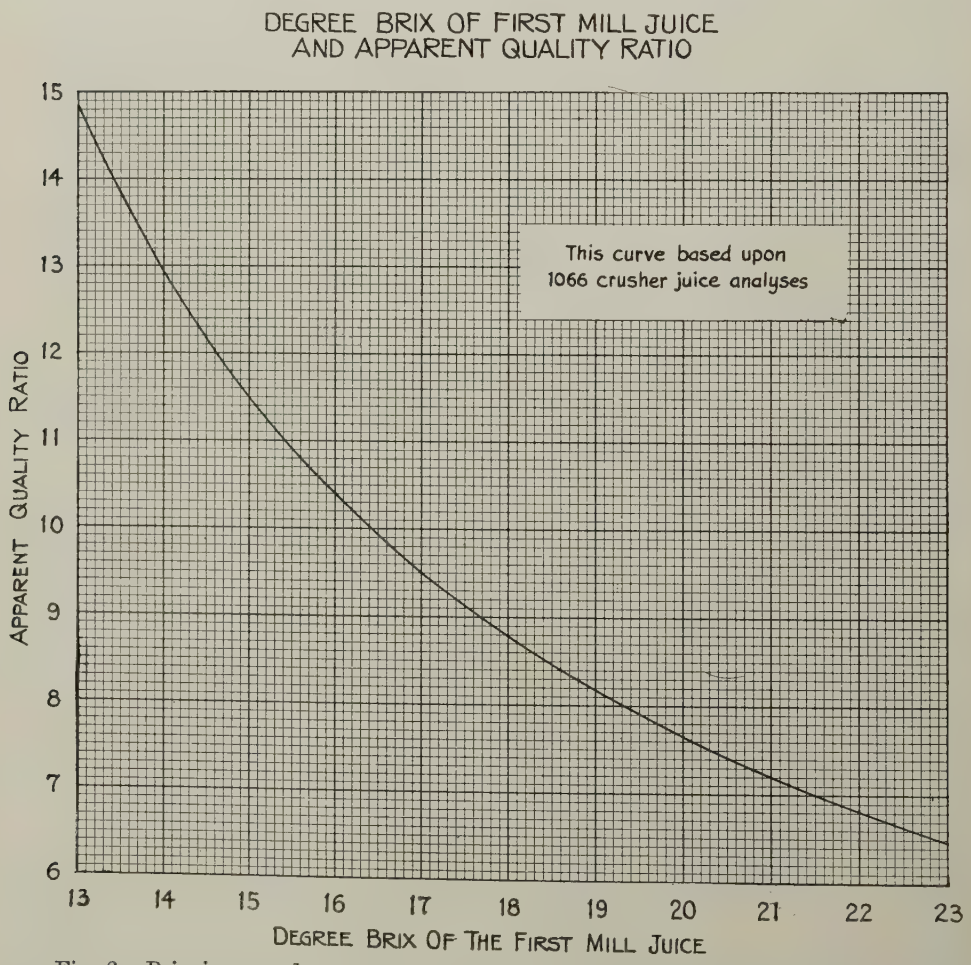

Fig. 2. Brix is a good measure of Quality Ratio where normal Purities exist. Interpolation on the curve above will give a good measure of Quality Ratio in such cases.

a hand refractometer on each of these composites. The entire stool of cane was then crushed in the small mill and the juice given the routine analysis for per cent recoverable sucrose. Correlation coefficients were then calculated for the Brix at the different locations in the stalk versus the final per cent recoverable sucrose. These are as follows:

Description of correlation	Coefficient of correlation factor	Probable error of coefficient of correlation factor
Brix of lower internodes vs. per cent recoverable sucrose from entire stool	.694	±.012
Brix of middle internodes vs. per cent recoverable sucrose from entire stool	.707	±.012
Brix of upper internode vs. per cent recoverable sucrose from entire stool	.495	±.012

These coefficients of correlation factors clearly show that the mature portion of the stalk is the best source of a juice sample which will be most representative of the whole.

The next item to be checked before the "juice punch" and hand refractometer can be used with surety in the field is the number of stalks which must be sampled to give a figure which is reasonably close to the true mean. The probable error of a single stalk can be quickly determined by reading the Brix on 15 to 25 individual stalks in the field and calculating it by Bessel's formula:

$$\text{P. E. (single observation)} = .6745 \sqrt{\frac{\Sigma d^2}{n-1}}$$

Then with the use of Denny's formula, explained in the early part of this paper, it is possible to find the number of stalks needed for the different degrees of accuracy desired. For purposes of illustration the following data are presented on four varieties growing in an experiment at Honolulu Plantation Company. The cane is in Field 89 and was 12 months old at the time the stalks were sampled with the punch sampler and the juice read for Brix by the hand refractometer.

Variety	Average Brix for 25 stalks	P.E.s.o. in per cent	The *number* of *stalks* required to give the *true Brix* within the limits of an error of: 3 per cent	6 per cent
31-1389	18.4	4.4	22	6
P.O.J. 2878	21.7	1.9	4	1
28-1234	17.4	3.8	16	4
29-7617	16.6	4.8	26	7

These figures show a greater degree of variation in stalk-to-stalk analyses in some varieties than others. It is likewise true that some fields of the same variety will show a greater degree of variation than others.

Summary: In sampling a population of sugar cane stalks for the best measure of the sucrose content, the greatest error to overcome is the stalk-to-stalk variation. The number of stalks needed for a reliable figure for such a population increases rapidly as the stalk-to-stalk variation increases, with the result that in many cases

the number required is beyond practical field scale operation. A punch sampler has been developed which draws a few drops of juice from a stalk without injuring it and is so rapid in manipulation that many stalks can be sampled with little effort. A coefficient of correlation factor is shown which indicates that a sample of juice drawn from the middle dry-leaf portion of the stalk is the best representative sample of the whole stalk. A hand refractometer reading of the juice sample will tell the total solids in solution (Brix) which is a reliable measure of per cent recoverable sucrose. This premise is supported by numerous correlations between Brix and recoverable sucrose. A method is described by which the number of stalks needed to obtain a true measure of the Brix for the population can be calculated for different expected errors.

II. Basic Studies with the Hand Refractometer

The usual method of cutting cane stalks in the field and bringing them to the laboratory for the extraction and subsequent analysis of juice is admittedly a burdensome process.

This method is also not very satisfactory when an attempt is being made to study the joint-to-joint variation in juice quality in order to gain an understanding of the fundamental manner in which sugars accumulate in cane. Furthermore, this method is of no use whatsoever when it is desired to study the changes in the same part of the plant from time to time.

The development in recent years of a suitable instrument for puncturing the joint and extracting the juice has opened up a large field of fruitful research. Equipped with this instrument and the hand refractometer we are now in a position to study the joint-to-joint variations in a large number of cane stalks in a very convenient manner within a short time. Moreover, we can with proper precautions, study the changes that take place in the same joint as the stalk grows older.

A large amount of work of this nature has been done at the Experiment Station in the last two years and some of the results have already appeared in *The Hawaiian Planters' Record,* First Quarter, 1934. From these extensive studies, we have found that a cane stalk can be divided into two main portions from the point of view of sugar concentration—namely, the dry-leaf part and the remaining portion of the stick containing the millable green-leaf cane and the non-millable top. The dry-leaf part is that part of the stalk where the leaves that were once firmly attached to the nodes have died and fallen off. In general we find that the concentration of Brix is quite uniform from joint to joint within the entire dry-leaf section, but that it falls off rapidly and steadily from that point on as we go farther up the stalk. In interpreting the data we have come to the tentative conclusion that accumulation of sugars in a cane stalk is a joint-by-joint process and that by the time the leaf attached to a joint has fallen off, that joint has already attained a state of maturity. In other words, these joint-to-joint studies indicate that accumulation of sugar in cane is not to be looked upon as something distinct or apart from the general growth process. As the cane grows a joint is formed, and that joint matures. Even in an 8 or 10-month-old stalk there are joints that have already reached as high or almost as high a concentration of sugar as they ever will.

In the final analysis the most fundamental question that confronts us in solving the problem of maturity in cane is this: Can a joint once completely developed, i. e., attained a dry-leaf status, increase in sucrose concentration? The only way the question can be solved is by analyzing the same joint from time to time. The hand refractometer method is the only one available to us at present to make such a study. We have similar studies under progress already, but the results to date are too fragmentary to be reported upon. In these studies we puncture a joint at one point this time and the next time at another point well removed from this first puncture. After each puncture, we seal up the broken tissue with putty or plastic wood to minimize infection. We have been making observations at intervals of two months. We find that infection still spreads and, therefore, the number of observations that can be made on the same joint depends on the size of the joint. If the joint is small, the infection spreads so far that we cannot make another puncture without striking deteriorated tissue and, of course, as soon as we do this the readings become unreliable. On the other hand, if the joints are big we can make two or three punctures in each joint without running into trouble. There is every reason to believe that we may be able to improve our manner of extracting the juice and subsequent sealing up the wound by which tissue deterioration will be lessened if not eliminated. But even two punctures in the same joint at two-

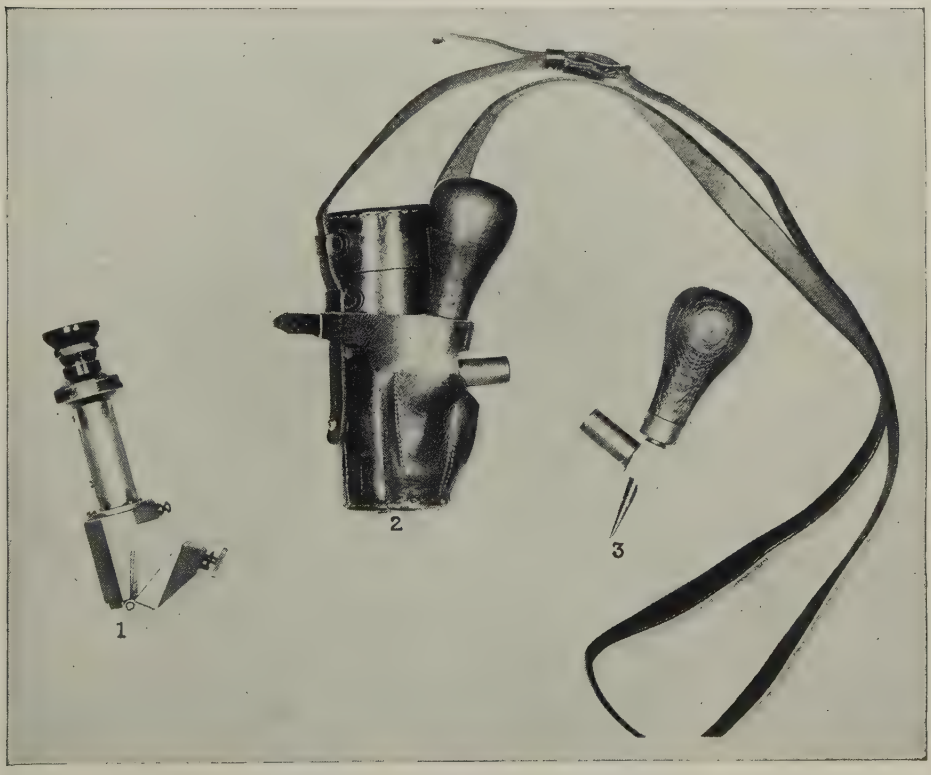

Fig. 3. The hand refractometer (1) and the punch juice sampler (3) are suitable equipment for obtaining a rapid and comparatively accurate analysis of the sucrose content of growing cane.

month intervals ought to tell us something and the data obtained so far appear to do so.

The brief account given here is merely to indicate the many uses to which this simple equipment can be put for the purpose of conveniently obtaining an insight into inner processes of cane life. There is little doubt that the future will see a great expansion of studies of this type, made possible for the first time by the equipment herein described.

III. Some Practical Uses for the "Punch Juice Sampler" and Hand Refractometer in the Cane Fields

A. Comparative Studies on Seedlings.

The figure for total solids in solution (Brix) as shown by the refractometer has been used by the Experiment Station since 1917 as an expression of sucrose content of seedlings which are in the preliminary stages of testing. It has provided a rapid means of securing information on this important quality where thousands of seedlings must be examined.

In taking a juice sample for the Brix reading on a seedling a composite sample consisting of the juice squeezed from the middle portion of the dry-leaf section of the stalk is collected from a specified number of stalks. In the preliminary trials at the Kailua substation and the Field Trial 1 tests at the Regional stations between one-half and all the stalks in the plot are sampled for the composite. In larger plots such as in the Field Trial 2 tests where many stalks are available for sampling, a large enough number is sampled to insure a composite which will be representative of the whole. This number is determined by the stalk-to-stalk variation found in the cane under test at the time of harvest, as explained in Section I of this paper.

The development of the punch sampler offers a rapid way for obtaining a juice sample of seedlings. It also gives the operator a good idea of the relative hardness of the seedlings as he works with them.

B. Preharvest Juice Sampling to Determine Relative Ripeness of Fields.

A recent publication from Java (4) tells of the use of a punch and refractometer similar to those illustrated in Fig. 3, as a means of obtaining preharvest juice samples on fields which are approaching maturity. The system evolved from these instruments is preferred to the one in vogue where whole stalks are cut from the field, because it allows for the sampling of many more stalks and the obtaining of a figure which more nearly approaches the true mean for the field.

In studying the ripening of a field of cane there are two sections of the cane stalk which should be considered separately, i. e., the mature section and the immature section. The mature section is the lower dry-leaf portion of the stalk and may be considered as that part of the stalk where sucrose storage is nearly at a maximum, and therefore an index of what the field is capable of yielding. The immature section includes the green-leaf part as well as the 6 to 8 joints immediately below the last adhering green leaf. For convenience these may be designated as "A," the mature section, and "B," the immature section.

In the process of ripening it is assumed that as either or both of the elements

Fig. 4. The relationship of the Brix at "A" (the mature section) to "B" (immature section) is a measure of the ripeness of the stalk of cane. Thus as "B" approaches "A" the stalk is nearing maximum maturity.

nitrogen and water become limiting, the vegetative growth of the cane is slowed down and therefore will allow a greater storage of energy in the form of sucrose. It is also assumed that the "B" section of the stalk will be influenced the most since it is here that there is a changing Brix.

The mature dry-leaf portion will not improve in sucrose content although the concentration of the quantity in solution may increase through the simple expedient of evaporation as the whole stalk loses moisture on drying out.

With these two premises in mind the ripeness of a field will not be the sucrose content of the stalks as a whole, but that of the upper "B" section in relation to the mature "A" section. Thus the ripeness can be expressed as:

$$\frac{\text{Brix of "B" section}}{\text{Brix of "A" section}} = \text{per cent ripeness of "B" section.}$$

The following data were collected from varieties in an experiment at Honolulu Plantation Company, two months before the scheduled harvest.

Cane 12 months old—irrigations every 15 days—25 stalks used for each sample —4 samples taken on each variety from different locations in the experiment.

Variety	Sample No.	Brix of Mature (Section A)	Brix of Immature (Section B)	Per cent Ripeness of Section B
P.O.J. 2878.....	2-a	22.0	17.3	80
	b	21.7	17.9	83
	c	22.2	18.1	81
	d	19.6	15.2	78
31-1389	3-a	18.4	14.9	81
	b	18.4	14.9	81
	c	19.4	14.8	76
	d	17.8	14.1	80
28-1234	1-a	17.4	13.1	76
	b	17.6	13.8	78
	c	17.6	13.0	74
	d	16.2	11.9	73

Note: The "d" samples were collected from a section of the experiment where all the varieties had made a greater vegetative growth than in other parts of the experiment. This has apparently been done at the expense of sugar storage for the Brix in the mature "A" section is lower in all cases.

It is interesting to note that ripeness of the "B" section is quite consistent within a variety, but differs among varieties.

In all preharvest juice sampling work the key to successful results lies in the careful selection of sampling stations which will give the best weighted average for the whole field. W. Wolters (5, pp. 413-14) stresses this point and specifies one station for approximately every 15 acres in a field. Where conditions are quite variable this ratio might be decreased to insure greater accuracy.

C. An Aid in Determining the Profitable Height for Topping the Cane in the Harvesting Field.

It is a common practice on plantations to top low in the early part of the harvesting season and higher as the summer months approach. J. D. Bond (1) sup-

ports this practice with an extensive set of data collected at Ewa Plantation Company. With this differential in height of maturity in the cane stalk as established by long experience as well as by experimental evidence, it may be assumed that there are minor variations of maturity in the green-leaf portion of the stalk from field to field or from variety to variety which would be profitable to determine. The punch sampler and refractometer offer rapid means for making such a determination.

A conservative calculation will illustrate the value of each foot of stalk of H 109 cane in terms of tons cane per acre:

24,000 stalks per acre — one foot of cane weighs .50 pound.
24,000 × .5 = 12,000 pounds, or six tons per acre.

The question of whether these six tons of cane should be saved resolves itself into the relationship of a number of factors with one another, i. e., (1) sucrose content of this cane, (2) price of sugar, and (3) the various costs controlled by cane weight such as harvesting, milling, and long-term contracts.

The relation of Brix to per cent recoverable sugar is not the same in the immature green-leaf portion of the stalk as in the mature dry-leaf portion of the

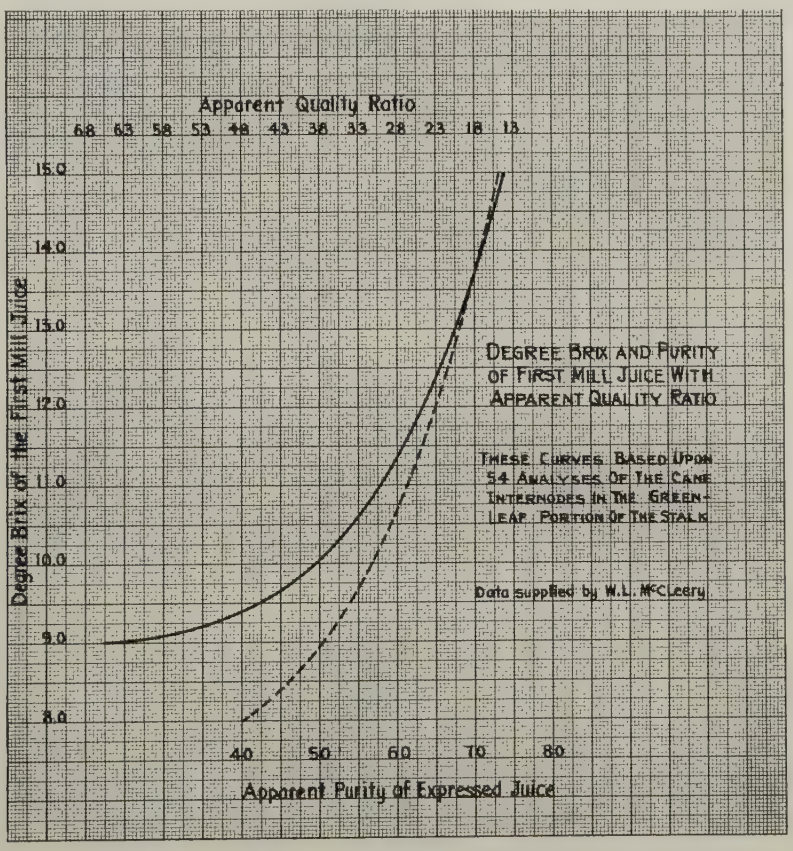
Apparent Quality Ratio
6.8 6.3 5.8 5.3 4.8 4.3 3.8 3.3 2.8 2.3 1.8 1.3
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
Degree Brix of the First Mill Juice
4.0 5.0 6.0 7.0 8.0
Apparent Purity of Expressed Juice
Degree Brix and Purity of First Mill Juice With Apparent Quality Ratio
These Curves Based Upon 54 Analyses Of The Cane Internodes In The Green-Leaf Portion Of The Stalk
Data supplied by W.L. McCleery

Fig. 5. Interpolating for apparent Quality Ratio from Brix readings made in the green-leaf portion of a stalk should be done on this curve since it is based upon analyses from this region where the purity is low.

stalk for in this area there is concentrated a large proportion of non-sucrose solids. The result is that as the growing point is approached the purity becomes lower. A correlation curve (Fig. 5) based upon the analysis of juice from internodes within the green-leaf section of the stalk shows this property of purity to decrease in this region as the Brix becomes lower.

A few drops of juice from the upper internodes of a number of stalks chosen at random in the harvesting field will give a fair idea as to how far ripeness is extending into the green-leaf portion of the stalk. The apparent Quality Ratio can be roughly interpreted by interpolating the Brix reading on the curve shown in Fig. 5.

IV. Use of "Punch Juice Sampler" and Hand Refractometer in Formosa.

In Formosa, factory operators buy the cane from small planters. The sugar cane is therefore a merchandise and its value is usually reckoned on the basis of weight. Consequently the buyers are greatly concerned with the quality of the cane, whereas the farmers are interested in the weight.

The good quality of cane is maintained by setting a limit on the amount of fertilizer to apply, by preharvesting tests, and by eliminating trash, dirt, and sour stalks.

To determine just when to cut a field of sugar cane, a man armed with a punch juice sampler and a hand refractometer, enters the field and selects sound stalks from different points along a diagonal line of a field. Fields in Formosa range in size from about a quarter of an acre to three or four acres. Each stalk is tested separately at three different points, about a quarter-way up from the ground, in the middle, and at a top joint near the node to which the seventh or the eighth open leaf attaches itself to the stalk. Brix only is read. At first the top shows a low Brix, but as the season advances the readings equalize, and then the cane is thought to be ripe. The tests are made approximately once a month, beginning the end of November.

The harvesting usually starts in January and ends in April.

Even a small field may be divided into different parts if it shows differences with respect to: growth, amount of lodging, extent of damage, and the degree of ripeness. These are then tested separately.

A mill operator may have ten or more men testing cane throughout the area from which the cane is purchased, and whenever the actual recovery figure fails to come up to the expected figure, an examiner is sent to the field immediately to decide whether or not to discontinue the harvesting operation and to study the causes of the disagreement between the previous study and the actual recovery at the mill. The reasons usually found for the disparity are:

Error in the preharvesting tests.
Wind damage to the leaves.
Sudden insect and disease attacks.
Flooding of the field.

Selective harvesting is practiced even in small fields, disregarding almost entirely the convenience of the harvesting gang.

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A Pot Experiment With Cane Grown in the Same Soil But Under Different Climatic Conditions

By U. K. Das

The present paper gives the results of a preliminary experiment designed to study the effect of climatic environment on cane growth when all other growth conditions including the soil are kept constant.

The experiment was carried on simultaneously at the main Experiment Station at Makiki, and at the substation at Manoa. These stations possess climatic characteristics which are entirely different from each other, but each station is representative of large cane areas in these Islands. At Makiki the mean annual maximum temperature is about 85° (*), total annual rainfall about 40 inches, and the cane here is grown entirely by irrigation. The mean annual maximum temperature at Manoa is about 79°, total annual rainfall about 160 inches, and the cane here is normally grown without irrigation, although for the purpose of this experiment the cane was occasionally irrigated when rainfall was deficient in any period. The Manoa substation suffers from the further disadvantage of being subject to strong winds and to being cast in shadow in the afternoon due to the intervention of a mountain range. The climatic conditions at Makiki would thus be typical of irrigated areas in Oahu, while that of Manoa of some areas in Hawaii.

The cane was planted in tubs. Each tub measured two feet on each side and two feet in depth, giving a capacity of eight cubic feet of soil. All the tubs were filled with good Makiki soil, which is rich in phosphates and potash. Manoa soil on the other hand is very deficient in both of these nutrients. Six of these tubs containing the Makiki soil were transported to the Manoa substation and placed in a favorable location. Six similar tubs were kept in Makiki.

On August 9, 1933, three tubs in each location were planted with uniform seedpieces of P.O.J. 2878 and P.O.J. 36, respectively, containing equal number of eyes. Two varieties were used so that the differential climatic adaption, if any, could also be studied.

The tubs were fertilized on the same day at both the locations. The fertilizer was a mixture of N, P_2O_5, and K_2O and was applied at three different times. At Makiki the tubs were always kept well watered, at Manoa occasional irrigation was applied to make up for the deficiency of rainfall at any period. Thus, as far as possible, all the conditions of growth were equal in both places with the exception of those that were climatic, namely: temperature, light, wind, etc.

The test was harvested on August 1, 1934, at the age of approximately 12 months. Tables I and II give the yield of green matter. Fig. 1 shows the stand

(*) In comparison with the U. S. Weather Bureau's Honolulu Office record of an annual mean maximum temperature of about 80° F., the Makiki average of 85° would appear too high. This might be due to the influence of the particular spot where the thermometer is housed at Makiki, as the thermometer itself has been found to be correct.

Fig. 1. Showing the differences in growth of P.O.J. 2878 and P.O.J. 36 at Manoa and Makiki. The canes were in large concrete tubs containing Makiki soil only. These striking differences that are undoubtedly due to environmental influences only, would suggest that the soil differences have little influence on yields.

of cane obtained from typical tubs in this test. Table III shows the quality of juice.

TABLE I
Yield in Pounds

MANOA SUBSTATION

	Green Weight	Millable Cane Weight	No. of Millable Sticks	Dry Trash
P.O.J. 2878:				
Tub 1	10.06			
Tub 2	12.81			
Tub 3	12.19			
Total Weight	35.06	16.56	37	6.25
P.O.J. 36:				
Tub 1	14.50			
Tub 2	14.31			
Tub 3	12.39			
Total Weight	41.20	22.19	46	5.44

MAKIKI STATION

P.O.J. 2878:				
Tub 1	28.44		22	4.75
Tub 2	26.19		18	4.19
Tub 3	30.13		19	4.50
Total Weight	84.76	49.25	59	13.44
P.O.J. 36:				
Tub 1	32.39		29	
Tub 2	29.25		24	
Tub 3	38.00		24	
Total Weight	99.64	63.39	77	12.25

TABLE II

Relative Yield Due to Varieties and to Locations

$\frac{\text{P.O.J. 36}}{\text{P.O.J. 2878}}$	Manoa	Makiki
Ratio of green weight..	1.175	1.176
Ratio of millable cane..	1.34	1.28
Ratio No. of sticks.....	1.24	1.31
Ratio dry trash	0.87	0.91

Ratio $\frac{\text{Manoa}}{\text{Makiki}}$	P.O.J. 2878	P.O.J. 36
Total green weight..	2.42	2.42
Total millable cane.	2.97	2.86
Total No. of sticks.	1.59	1.67
Total dry trash.....	2.15	2.25

TABLE III

Quality of Juice

MANOA	P.O.J. 36	P.O.J. 2878
Sucrose	17.38	15.37
Glucose	0.36	0.57
Gravity Purity	89.96	87.43
Q. R.	7.66	9.01

MAKIKI	P.O.J. 36	P.O.J. 2878
Sucrose	18.37	17.79
Glucose	0.24	0.48
Gravity Purity	90.81	89.49
Q. R.	7.30	7.64

Yield of Cane:

The results show that both varieties yielded more green matter at Makiki than at Manoa and by exactly the same relative amount. P.O.J. 36 was 2.42 times better at Makiki than at Manoa, as was P.O.J. 2878. The climatic effects on the yields of the two varieties were also very nearly the same in the matter of millable cane, number of sticks, and dry trash. This striking difference in the yields of two varieties at Makiki and Manoa would strongly suggest the preponderance of climatic effects over other growth conditions. Such differences when encountered on different areas of plantations would often be attributed in large part to soil conditions.

Table II also shows that P.O.J. 36 yielded just as much more than P.O.J. 2878 at Manoa as it did at Makiki. In other words, in the matter of green matter, number of sticks, etc., there can be seen no differential adaptability of these two varieties to the climatic differences. This comes somewhat as a surprise, because it was felt from experience that P.O.J. 2878 might do relatively better at Makiki than at Manoa.

Juice Quality:

In the matter of juice quality Makiki environment appears to be considerably better than Manoa. This is quite in agreement with the results of our previous weather studies wherein it was shown that a location with wider range of daily temperature usually gave better juices than another where the daily range was much smaller. It would also appear from the results that P.O.J. 36 was better suited to make good juice at Manoa than at Makiki. There was a difference due to environment of more than two per cent of sucrose in P.O.J. 2878, while this difference was only one per cent in the case of P.O.J. 36.

Climatic Factors:

It is not possible to precisely evaluate the magnitude of differences of all the climatic factors. We have, however, sunlight data which show that Makiki had approximately 40 per cent more sunlight than Manoa. Effective temperature as measured by day-degrees (base line 70° F. of mean maximum temperature) was 5663 at Makiki and 3477 at Manoa, or a difference of 64 per cent in favor of Makiki (this difference would be much greater if a higher base line were used to compute day-degrees). We have no data on wind which is a factor of considerable importance in this present study as on several occasions the cane at Manoa was very badly damaged by strong winds. During the period of the experiment 131 inches of rain fell at Manoa.

Summary:

This experiment makes specific measurements of different aspects of growth of two varieties of cane as influenced by climatic differences only; the soil factor being held constant. P.O.J. 36 and P.O.J. 2878 appear to respond to the climatic factors in the same manner and to the same extent. Makiki climate is far better than Manoa climate in the matter of yield and quality. P.O.J. 36 appears to be better adapted to Manoa in the matter of quality than P.O.J. 2878.

In conclusion, the preliminary nature of the experiment must be emphasized. The results given here are of definite interest only as far as they point to the desirability of further research along similar lines.

The Experiment Station has already under way a more elaborate experiment of this kind.

Plantation Fertilizer Practices

By D. S. Judd and R. J. Borden

A paper entitled "Present Fertilizer Practices on the Sugar Plantations of the Hawaiian Islands" was presented in 1924 at the third annual meeting of the Association of Hawaiian Sugar Technologists by J. A. Verret. This paper gave the compiled answers to questionnaires which had been circulated among the various plantations, and included a discussion of the mixed fertilizers used, their composition, and their relative merits. At the 1928 meeting of the A. H. S. T. an article was presented by W. W. G. Moir on "Soils and Fertilizers" which gave a general survey of the plantation fertilizer practices of that date. Another article of a similar nature which appeared the following year was written by G. R. Stewart, and included a graphical presentation intended to show the relationship of the time of application of fertilizers to the respective starting and harvesting dates.

"Present Day Fertilizer Practices" by H. P. Agee, which was presented at the 1931 meeting of the Hawaiian Sugar Planters' Association, presented a clear and simple graphic form for recording different fertilizer practices, which has been used since that time in the presentation of data of this nature. It was used in 1932 at the annual meeting of the H. S. P. A. by J. A. Verret in his article "The Year's Developments in Fertilizer Practices and Economies." It is used again in this paper which has been prompted by a suggestion that these printed fertilizer schedules be kept up-to-date, in order that the various changes and trends may be recorded and followed by those who are interested.

We acknowledge the cooperation of the various plantation men, and the island representatives of the Experiment Station who assisted us in the gathering of the data for this present work.

The principal general changes noted are the wider use of simple fertilizers, and the trend toward the differential fertilization of fields from the results of analytical soil analyses and experimental work.

In 1932, four plantations were using simples alone with no mixed fertilizers. We note that this year ten plantations are following this practice. Five plantations are using more simples than formerly with no increase in the number of mixed fertilizers used. On the other hand, we note that nine plantations are using more fertilizer mixtures than in 1932, but of these, five are also using more simples. Six plantations indicate no change in the types of fertilizers used since the 1932 schedule.

It will be noted that more of the plantations are fertilizing along the lines of the actual needs of the fields as indicated by field experiments and the results of chemical analyses and pot studies. The idea of a general practice for the whole plantation is fading out; individual field fertilizer needs are being studied, and further, spot fertilization within the individual fields is being practiced.

COMPARISONS OF FERTILIZERS USED IN 1932 AND 1934

PLANTATIONS	1932 MIXED FERTILIZER	1932 SIMPLES	1934 MIXED FERTILIZER	1934 SIMPLES
HAWAII				
HUTCHINSON	B-24	Ammo. Sul.		Mur. Pot. Ammo. Phos. Ammo. Sul.
HAWAIIAN AGR.	B-21	Ammo. Sul.	B-21	Ammo. Sul. Superphos.
OLAA	A-11 A-12		A-11 A-12	
WAIAKEA	M.F. 10-5-20		M.F. 6-10-25 M.F. 10-5-20	Ammo. Sul.
HILO	B-19	Ammo. Sul.	B-19	Ammo. Sul.
ONOMEA	B-19	Ammo. Sul.	B-19	Ammo. Sul. Ammo. Phos. Chile Pot. Nit. Mur. Pot.
PEPEEKEO	B-19	Ammo. Sul.	B-19	Ammo. Sul. Treble Super Chile Pot. Nit.
HONOMU	B-17	Ammo. Sul.	B-17	Ammo. Sul.
HAKALAU	B-17	Ammo. Sul.	B-25	Chile Pot. Nit.
LAUPAHOEHOE	M.F. 11-8-20	Ammo. Sul.	M.F. 11-8-20	Ammo. Sul.
KAIWIKI	M.F. 15-9.5-15	Ammo. Sul.		Chile Pot. Nit. R. R. Phos.
HAMAKUA	M.F. 12.4-9.6-18	Ammo. Sul.	M.F. 14.25-12.25-14.5	Ammo. Sul.
PAAUHAU	P-1	Ammo. Sul.	P-2	Ammo. Sul.
HONOKAA	A, B, C, D } Home Mixed		A, B, C, D } Home Mixed	
KOHALA	NOT REPORTED			Ammo. Sul. Ammo. Phos. Nit. Lime Mur. Pot. Nit. Pot.
UNION	M.F. 7.5-15.5-26	Ammo. Sul.	M.F. 9.3-13.3-20	Ammo. Sul.
KAUAI				
KILAUEA	K-8	Ammo. Sul.	K-8	Ammo. Sul. Chile Pot. Nit.
LIHUE	A-16	Ammo. Sul. Urea Nit. Potash	A-20	Ammo. Sul. Chile Pot. Nit.
GROVE FARM	P.S. 5A	Ammo. Sul. R.R. Phos. Superphos.	P.S. 5A P.S. 5AX	Ammo. Sul. R. R. Phos.
KOLOA	A-16 X-50		A-16 A-20 X-50A	Ammo. Sul. Chile Pot. Nit.
McBRYDE	McB.-A	Ammo. Sul. Ammo. Phos. R.R. Phos. Mur. Pot.		Ammo. Sul. Ammo. Phos. R. R. Phos. Mur. Pot.
HAWAIIAN SUGAR	H.S.-2	Ammo. Sul. Nit. Soda	H.S.-2 H.S.-3 H.S.-4	Ammo. Sul. Nit. Soda Mur. Pot. Chile Pot. Nit.
WAIMEA	A-17	Ammo. Sul. Nit. Pot.	A-17 X-50A	Ammo. Sul. Nit. Soda
KEKAHA	A-17	Ammo. Sul. Nit. Pot.	A-17 X-50A X-56	Ammo. Sul. Nit. Soda

COMPARISONS OF FERTILIZERS USED IN 1932 AND 1934—Continued

PLANTATIONS	1932 MIXED FERTILIZER	1932 SIMPLES	1934 MIXED FERTILIZER	1934 SIMPLES
MAUI				
PIONEER	A-17	Ammo. Sul. Nit. Pot.	A-17 A-19 X-35	Ammo. Sul. Ammophos. A Nit. Pot. Chile Pot. Nit.
WAILUKU	W-1	Ammo. Sul.		Ammo. Sul. Ammo. Phos. Mur. Pot.
H. C. & S. CO.	G-1 G-2 G-3	Ammo. Sul. Nit. Soda	G-2	Ammo. Sul. Nit. Soda Ammo. Phos.
M. A. CO.		Ammo. Sul. Ammo. Phos.		Ammo. Sul. Ammo. Phos.
OAHU				
WAIMANALO	Nalo - "C"	Ammo. Sul. Ammo. Phos. Mur. Pot.		Nit. Soda DiAmmo. Phos. R. R. Phos. Chile Pot. Nit.
KAHUKU		Ammo. Sul. Superphos. Mur. Pot.		Ammo. Sul. Ammo. Phos. Mur. Pot.
WAIALUA		Ammo. Sul. Superphos. Mur. Pot.		Ammo. Sul. Ammo. Phos. Superphos. Mur. Pot.
WAIANAE	A-15	Ammo. Sul. Urea Nit. Pot.	A-15 A-21	Ammo. Sul. Chile Pot. Nit. Urea/Nit. Pot.
EWA		Ammo. Sul.* Nit. Soda Nit. Pot. Mur. Pot.		Ammo. Sul. * Nit. Lime Chile Pot. Nit. Mur. Pot.
OAHU	A-14	Ammo. Sul. Nit. Soda	A-14 A-15	Ammo. Sul. Nit. Soda
HONOLULU	F-1 F-2 F-3 F-4	Ammo. Sul.	A, B, C, D, E, F, G, H } Home Mixed	Ammo. Sul. Nit. Lime

* Ewa — 1st Ammo. Sul. application may be Ammo. Phos. if field requires P_2O_5.

Examples of many of the specific fertilizer schedules for the plantations are submitted herewith:

List of Abreviations Used

A.P. = Ammonium Phosphate.

A.P.A. = Ammonium Phosphate "A."

A.S. = Ammonium Sulfate.

C.P.N. = Chile Potash Nitrate.

Di.AP = Diammonium Phosphate.

H.G. = High Grade.

Mol.Ash = Molasses Ash.

M. F = Mixed Fertilizer.

M.P. = Muriate Potash.

N.L. = Nitrate of Lime.

N.P. = Nitrate of Potash.

N.S. = Nitrate of Soda.

R.R.P. = Raw Rock Phosphate.

Super = Superphosphate

T.S.P. = Treble Superphosphate.

A-16, K-8, P.S.5AX = Trade names of mixed fertilizer.

Wks. = Weeks.

Mos. = Months.

Appl. = Application.

KEY

Kind of Fertilizer	N	P_2O_5	K_2O
	— %	— %	— %
—# P.A.	—# P.A.	—# P.A.	—# Per Acre

HUTCHINSON S.P.CO.

Fields very deficient in P_2O_5 and K_2O

①	A.P. 500	13	65	48 240	Immediately after start
②	A.S. 200	20.5	41		2½ months after ①
	M.P. 218¾			60 131	,,
③	A.S. 300	20.5	61.5		2½ months after ②
	M.P. 250			60 150	,,
④	A.S. 200	20.5	41		3 months after ③
	Total	208.5	240	281	

Fields with good supply of P_2O_5 and K_2O

①	A.P. 218¾	13	28.5	48 105	Immediately after start
	A.S. 200	20.5	41		(not applied in plant crop)
②	A.S. 200	20.5	41		2½ months after ①
③	A.S. 300	20.5	61.5		2 months after ②
	M.P. 166¾			60 100	,,
④	A.S. 300	20.5	61.5		3 months after ③
	Total	233.5	105	100	

Fields moderately deficient in P_2O_5 and K_2O

①	A.P. 312½	13	40.5	48 150	Immediately after start
②	A.S. 300	20.5	61.5		2½ months after ①
③	A.S. 300	20.5	61.5		2½ months after ②
	M.P. 250			60 150	,,
④	A.S. 300	20.5	61.5		3 months after ③
	Total	225	150	150	

Fields very high in P_2O_5 and K_2O

①	A.S. 300	20.5	61.5		Immediately after start
②	A.S. 300	20.5	61.5		2 months after ①
③	A.S. 300	20.5	61.5		2 months after ②
④	A.S. 200	20.5	41		3 months after ③
	Total	225.5			

HAWAIIAN AGRI. CO.

Plant cane - all fields

①	B 21 250	9	22.5	20 50	10 25	With seed
	Super 375			20 75	
②	B 21 375	9	33.75	20 75	10 37.5	No regular interval; when thought advisable
③	A.S. 300	20.5	61.5			,,
④	B 21 375	9	33.75	20 75	10 37.5	,,
⑤	A.S. 450	20.5	92.25			,,
	Total	243.75	275	100		

Ratoons-all fields

①	B21 375	9	33.75	20 75	10 37.5	No regular interval; when thought advisable
	Super 375			20 75		,,
②	A.S. 300	20.5	61.5			,,
③	B21 625	9	56.25	20 125	10 62.5	,,
④	A.S. 450	20.5	92.25			,,
	Total	243¾	275	100		

OLAA SUGAR CO.

Olaa - Pahoa - Kapoho Sections

①	A-11 300	15	45	7 21	15 45	All fertilizer is on 9-12 months after harvest
②	A-11 400	15	60	7 28	15 60	,,
③	A-11 400	15	60	7 28	15 60	,,
④	A-11 300	15	45	7 21	15 45	,,
	Total	210	98	210		

Mountain View Section

①	A-12 300	15	45	5 15	18 54	All fertilizer is on 9-12 months after harvest
②	A-12 400	15	60	5 20	18 72	,,
③	A-12 400	15	60	5 20	18 72	,,
④	A-12 300	15	45	5 15	18 54	,,
	Total	210	70	252		

WAIAKEA MILL CO.

All cane on average land 1935 crop					
①	A.S. 400	20.5 82			6-12 wks. after harvest
②	M.F. 625	10 62.5	5 31.25	20 125	16-24 "
③	M.F 625	10 62.5	5 31.25	20 125	32-40 "
Total	207	62.5	250		

All cane, average land 1936 crop					
①	A.S. 400	20.5 82			6-12 wks. after harvest
②	M.F. 1000	6 60	10 100	25 250	16-24 "
③	A.S. 400	20.5 82			32-40 "
Total	224	100	250		

HILO SUGAR CO

①	B19 500	7.5 37.5	15 75	25 125	2 weeks of age
②	B19 500	7.5 37.5	15 75	25 125	8 "
③	A.S. 300	20.5 61.5			16 "
④	A.S. 300	20.5 61.5			20 "
Total	198	150	250		

ONOMEA SUGAR CO.

Short ratoons					
①	B19 625	7.5 46.8	15 93.7	25 156¼	1st. hoeing
②	B19 625	7.5 46.8	15 93.7	25 156¼	2 months after ①
③	A.S. 400	20.5 82			3 months after ②
Total	175.6	187.4	312.5		

Mauka Poor soil 1936 crop					
①	A.P. 375	10 37.5	49 183.7		1st hoeing in plant On stubble in ratoons
②	M.P. 250			60 150	2 months after ①
③	C.P.N. 500	15 75		14 70	2 months after ②
④	C.P.N. 500	15 75		14 70	2 months after ③
Total	187.5	183.7	290		

Makai Good soils 1936 crop					
①	A.P. 250	10 25	49 122.5		1st. hoeing in plant On stubble in ratoons
②	M.P. 250			60 150	2 months after ①
③	C.P.N. 500	15 75		14 70	2 months after ②
④	C.P.N. 500	15 75		14 70	2 months after ③
Total	175	122.5	290		

PEPEEKEO SUGAR CO.

Plant and Ratoons 1935 crop

①	B 19	7.5	15	25	1 month after start
	500	37.5	75	125	
②	A.S.	20.8			1½-2 months after ①
	300	62.4			
③	B 19	7.5	15	25	2-2½ months after ②
	375	28.12	56¼	93¾	
④	A.S.	20.8			About 2 mos. after ③
	300	62.4			
Total		190.42	131¼	218¾	

Plant and Ratoons 1936 crop

①	T.SR.		40.5		1 month after start
	500		202.5		
②	C.P.N.	14.7		17.2	1½-2 months after ①
	700	103		120.4	
③	C.P.N.	14.7		17.2	2-2½ months after ②
	700	103		120.4	
Total		206	202.5	240.8	

HONOMU SUGAR CO.

Ratoons-above 750' elevation

①	B-17	7.5	7.5	25	At age of 1 month
	500	37.5	37.5	125	
②	A.S.	20.5			1 month after ①
	300	61.5			
③	B-17	7.5	7.5	25	(before hilling) 2 months after ②
	500	37.5	37.5	125	
④	A.S.	20.5			Within 5 months of start
	300	61.5			
Total		198	75	250	

Ratoons-below 750' elevation

①	B-17	7.5	7.5	25	At age of 1 month
	500	37.5	37.5	125	
②	A.S.	20.5			1 month after ①
	400	82			
③	B-17	7.5	7.5	25	Within 5 months of start
	500	37.5	37.5	125	
Total		157	75	250	

Plant cane at all elevations

①	B-17	7.5	7.5	25	At age of about 2 mos.
	250	18.75	18.75	62.5	
②	A.S.	20.5			1 month after ①
	300	61.5			
③	B-17	7.5	7.5	25	2 months after ②
	375	28⅛	28⅛	93¾	
④	B-17	7.5	7.5	25	(before hilling) About 2 mos. after ③
	375	28⅛	28⅛	93¾	
⑤	A.S.	20.5			Within 7-8 mos. of start
	300	61.5			
Total		198	75	250	

HAKALAU PL. CO.

①	B-25	10	7.5	25	About 2 months after harvest
	500	50	37.5	125	
②	B-25	10	7.5	25	5 months after harvest
	625	62.5	46.87	156¼	
③	C.P.N.	15		14	9 " " "
	500	75		70	
Total		187.5	84.37	351¼	

LAUPAHOEHOE S. CO.

①	M.F.	11	8	20	About 1 month after harvest
	375	41.25	30	75	
②	M.F.	11	8	20	(after hoeing) 1 month after ①
	375	41.25	30	75	
③	A.S.	20.5			(after hoeing) 1 month after ②
	200	41			
④	M.F.	11	8	20	4-6 months old cane
	375	41.25	30	75	
⑤	A.S.	20.5			Late fall or spring application
	300	61.5			
Total		226¼	90	225	

KAIWIKI SUGAR CO.

Mauka - above 1250' (Maximum)

①	R.R.P. 1350		37 500		With seed
②	C.P.N. 500	14.8 75		14.2 75	Within first 2 months
③	C.P.N. 500	14.8 75		14.2 75	June - August
④	C.P.N. 350	14.8 50		14.2 50	Feb. - March
Total	200	500	200		

Mauka-above 1250' (Minimum)

①	R.R.P. 400		37 150		With seed
②	C.P.N. 450	14.8 65		14.2 65	Within first 2 months
③	C.P.N. 450	14.8 65		14.2 65	June - August
④	C.P.N. 350	14.8 50		14.2 50	Feb. - March
Total	180	150	180		

Makai - below 1200' (Maximum)

①	R.R.P. 400		37 150		With seed
②	C.P.N. 700	14.8 100		14.2 100	Within first 2 months
③	C.P.N. 500	14.8 75		14.2 75	June - August
④	C.P.N. 350	14.8 50		14.2 50	Feb. - March
Total	225	150	225		

Makai - below 1200' (Minimum)

①	R.R.P. 300		37 100		With seed
②	C.P.N. 450	14.8 65		14.2 65	Within first 2 months
③	C.P.N. 450	14.8 65		14.2 65	June - August
④	C.P.N. 350	14.8 50		14.2 50	Feb. - March
Total	180	100	180		

HAMAKUA MILL CO.

①	M.F. 600	14.25 85.5	12.25 73.5	14.50 87	6 weeks of age
②	M.F. 600	14.25 85.5	12.25 73.5	14.50 87	4-6 months of age
③	A.S. 200	21 42			10-11 months of age
Total	213	147	174		

PAAUHAU S. P. CO.

Unirrigated

①	A.S. 400	20.8 83			As soon as possible
②	P-2 416	9.6 40	19.2 80	19.2 80	2 months after ①
③	A.S. 400	20.8 83			2 months after ②
Total	206	80	80		

Irrigated area started May to August

①	A.S. 800	20.8 166			As soon as possible after harvesting
②	P-2 416	9.6 40	19.2 80	19.2 80	
Total	206	80	80		

HONOKAA SUGAR CO.

Fields above Lower Ditch

①	A	15.26	13.44	14.91
	750	114.5	100.8	111.8
②	A	15.26	13.44	14.91
	750	114.5	100.8	111.8
	Total	229	201.6	223.6

Fields between Lower Ditch and R.R.

①	B	15.47	9.13	15.19
	750	116	68.5	114
②	B	15.47	9.13	15.19
	750	116	68.5	114
	Total	232	137	228

Fields below Railroad

①	C	12.48	6.99	11.93
	900	112.3	63	107.4
②	C	12.48	6.99	11.93
	900	112.3	63	107.4
	Total	224.6	126	214.8

Fields below Railroad (alternate)

①	D	15.66	7.47	14.91
	750	117.5	56	111.8
②	D	15.66	7.47	14.91
	750	117.5	56	111.8
	Total	235	112	223.6

Time of application for the above

If cane is started in Feb. or March

① As soon as practical

② Follows close upon ①

If cane is started - April to August

① and ② combined in one dose, as soon as practical

If cane is started after August

① Applied as soon as practical

② In Spring

KOHALA SUGAR CO.

Unirrigated - Nitrogen only

①	N.L. 300	15 45			4-6 weeks of age
②	N.L. 300	15 45			12-14 " "
③	N.L. 300	15 45			20 " "
④	N.L. 300	15 45			30 " "
Total	180				

Irrigated - Nitrogen only

①	A.S. 200	20.8 42			4-6 weeks of age
②	A.S. 300	20.8 62			12-14 " "
③	A.S. 350	20.8 73			18-20 " "
Total	177				

Unirrigated - Phosphates omitted

①	N.L. 300	15 45			4-6 weeks of age
②	N.P. 250	13.2 31		44.2 112	12-14 " "
③	N.L. 300	15 45			20 " "
④	N.L. 400	15 60			30 " "
Total	181			112	

Irrigated - Phosphates omitted

①	A.S. 200	20.8 42			4-6 weeks of age
②	M.P. 200			58.5 117	12-14 " "
③	A.S. 300	20.8 62			12-14 " "
④	A.S. 350	20.8 73			18-20 " "
Total	177			117	

Unirrigated - Complete Fertilizer

①	A.P.A. 250	10.7 27	49 123		(If plant - with seed) 2-4 weeks of age
②	N.P. 250	13.2 31		44.2 112	10 " "
③	N.L. 300	15 45			20 " "
④	N.L. 500	15 75			30 " "
Total	178	123		112	

Irrigated - Complete Fertilizer

①	A.P.A. 250	10.7 27	49 123		(If plant - with seed) 2-4 weeks of age
②	M.P. 200			58.5 117	10 " "
③	A.S. 200	20.8 42			10 " "
④	A.S. 500	20.8 104			18-20 " "
Total	173	123		117	

Irrigated - Short crops - Nitrogen only

①	A.S. 200	20.8 42			4-6 weeks of age
②	A.S. 400	20.8 83			12-14 " "
Total	125				

UNION MILL & PL. LTD.

Makai - below Gov't. Road

①	H.G. 375	9.3 35	13.3 50	20 75	1 month after harvest
②	A.S. 400	20.5 82			3 months " "
③	A.S. 300	20.5 61			10 " " "
Total	178	50	75		

Mauka - Central - above Gov't. Road

①	H.G. 375	9.3 35	13.3 50	20 75	1 month after harvest
②	A.S. 400	20.5 82			3 months " "
③	A.S. 200	20.5 41			10 " " "
Total	158	50	75		

KILAUEA S.P. CO.

Unirrigated cane other than Uba

①	K-8 750	4.5 33¾	26.6 199.5	14.9 111¾	Right after harvest
②	C.P.N. 300	13 39		14 42	4-6 wks. after ①
③	C.P.N. 325	13 42¼		14 45.5	6 Wks. after ②
	Total	115	199.5	199¼	

Irrigated cane other than Uba

①	K-8 750	4.5 33¾	26.6 199.5	14.9 111¾	With seed
②	A.S. 250	20.5 51¼			6 weeks after ①
③	A.S. 250	20.5 51¼			8 " " ②
④	A.S. 200	20.5 41			4 " " ③
	Total	177¼	199.5	111¾	

Uba cane ratoons

①	K-8 500	4.5 22.5	26.6 133	14.9 74.5	After harvest
②	A.S. 200	20.5 41			1 month after ①
	Total	63.5	133	74.5	

LIHUE PL. CO.

Mauka lands

①	A-20 800	6.25 50	31.25 250	17.75 142	At start
②	A.S. 200	20.5 41			1 month after ①
③	C.P.N. 400	15 60		15 60	2nd. season
	Total	151	250	202	

Middle lands (Late season-after July 1st.)

①	A-20 800	6.25 50	31.25 250	17.75 142	At start
②	A.S. 400	20.5 82			2nd. season
③	C.P.N. 400	15 60		15 60	" "
	Total	192	250	202	

Middle lands (Middle season-after Apr. 1st.)

①	A-20 800	6.25 50	31.25 250	17.75 142	At start
②	C.P.N. 200	15 30		15 30	1 month after ①
③	A.S. 400	20.5 82			2nd. season
④	C.P.N. 200	15 30		15 30	" "
	Total	192	250	202	

Makai lands (Early season)

①	A-20 400	6.25 25	31.25 125	17.75 71	At start
②	C.P.N. 300	15 45		15 45	1 month after ①
③	A.S. 200	20.5 41			1 month after ②
④	A.S. 350	20.5 72			2nd. season
⑤	A.S. 350	20.5 72			" "
	Total	225	125	116	

Middle lands (early season)

①	A-20 800	6.25 50	31.25 250	17.75 142	At start
②	C.P.N. 100	15 15		15 15	1 month after ①
③	C.P.N. 100	15 15		15 15	1 month after ②
④	A.S. 400	20.5 82			2nd. season
⑤	C.P.N. 200	15 30		15 30	" "
	Total	192	250	202	

Middle lands (Short Ratoons)

①	A-20 400	6.25 25	31.25 125	17.75 71	At start
②	C.P.N. 300	15 45		15 45	1 month after ①
③	A.S. 200	20.5 41			1 month after ②
④	A.S. 350	20.5 72			1½ months after ③
⑤	A.S. 350	20.5 72			1½ months after ④
	Total	255	125	116	

Makai land (Late season-after July 1st.)

①	A-20 400	6.25 25	31.25 125	17.75 71	At start
②	C.P.N. 300	15 45		15 45	1 month after ①
③	A.S. 200	20.5 41			2nd. season
④	A.S. 350	20.5 72			" "
⑤	A.S. 350	20.5 72			" "
	Total	225	125	116	

GROVE FARM CO.

Mauka - Plant - Unirrigated

①	R.R.P. 500		36 180		With seed
②	PS5AX 1500	.75 11	21 315	18.5 277.5	6 weeks after ①
③	A.S. 500	20.5 102.5			2-3 months after ②
	Total	113.5	495	277.5	

Mauka - Long and Short Rat. - Unirrigated

①	PS5AX 1250	.75 9.4	21 262.5	18.5 231¼	When field is cleaned up
②	A.S. 500	20.5 102.5			1-2 months after ①
	Total	111.9	262.5	231¼	

Makai - Ratoons - Irrigated

①	PS5A 1000	.75 7.5	21 210	18.5 185	At start
②	A.S. 400	20.5 82			6 weeks after ①
③	A.S. 400	20.5 82			3 months after ② or 2nd. season
	Total	171.5	210	185	

Middle belt - Ratoons - Irrigated

①	PS5A 1250	.75 9.4	21 262.5	18.5 231.3	At start
②	A.S. 400	20.5 82			6 weeks after ①
③	A.S. 300	20.5 61.5			3 months after ② or 2nd. season
	Total	152.9	267.5	231.3	

Makai - Plant - Irrigated

①	R.R.P. 400		36 180		With seed
②	PS5A 1000	.75 7.5	21 210	18.5 185	6 weeks after ①
③	A.S. 400	20.5 82			2-3 months after ②
④	A.S. 400	20.5 82			3 months after ③ or 2nd. season
	Total	171.5	390	185	

Middle belt - Plant - Irrigated

①	R.R.P. 400		36 180		With seed
②	PS5A 1500	.75 11	21 315	18.5 277.5	6 weeks after ①
③	A.S. 300	20.5 61.5			2-3 months after ②
④	A.S. 300	20.5 61.5			2nd. season
	Total	134	495	277.5	

KOLOA SUGAR CO

Mauka lands - Unirrigated

①	A-16 250	11 27.5	40 100		Right after harvest
②	A-16 375	11 41¼	40 150		6-8 weeks after ①
③	X50A 500	15.4 77		40 200	" " " ②
	Total	145¾	250	200	

Irrigated

①	A-16 375	11 41¼	40 150		Right after harvest
②	X50A 437.5	15.4 67⅜		40 175	6-8 weeks after ①
③	A.S. 500	20.5 102.5			6 weeks after ②
	Total	211⅛	150	175	

Mahaulepu Fields (Early cut) 1935

①	A-16 375	11 41¼	40 150		Right after harvest
②	X50A 375	15.4 57¾		40 150	6 weeks after ①
③	A.S. 350	20.5 71¾			" " ②
④	X50A 250	15.4 38.5		40 100	4-6 wks. after ③
	Total	209¼	150	250	

Mauka lands - Unirrig. & Irrig. middle belt

①	A-20 400	6.25 25	31.25 125	17.75 71	Right after harvest
②	A-20 400	6.25 25	31.25 125	17.75 71	6 weeks after ①
③	A.S. 200	20.5 41			4 " " ②
④	C.P.N. 400	15 60		14 56	4-6 " " ③
	Total	151	250	198	

Mahaulepu Fields (Early cut) 1936

①	A-20 500	6.25 31¼	31.25 156¼	17.75 88¾	Right after harvest
②	C.P.N. 300	15 45		14 42	6 weeks after ①
③	C.P.N. 300	15 45		14 42	6 " " ②
④	C.P.N. 300	15 45		14 42	4 " " ③
⑤	C.P.N. 250	15 37.5		14 35	4 " " ④
	Total	203¾	156¼	249¾	

Irrigated (Early cut)

①	A-20 500	6.25 31¼	31.25 156¼	17.75 88¾	Right after harvest
②	A.S. 200	20.5 41			6 weeks after ①
③	C.P.N. 300	15 45		14 42	6 " " ②
④	A.S. 200	20.5 41			4 " " ③
⑤	C.P.N. 300	15 45		14 42	4 " " ④
	Total	203¼	156¼	172¾	

McBRYDE SUGAR CO.

Group A

①	A.P. 375	10.5 39	48 180		6 weeks of age
②	A.S. 244	20.5 50			3 months of age
③	M.P. 250			60 150	3 " "
④	A.S. 244	20.5 50			5-6 " "
⑤	A.S. 317	20.5 65			8-12 " "
Total		204	180	150	

Group B

①	A.P. 375	10.5 39	48 180		Same as Group A
②	A.S. 244	20.5 50			" "
③	M.P. 250			60 150	" "
④	A.S. 244	20.5 50			" "
⑤	A.S. 244	20.5 50			"
⑥	A.S. 171	20.5 35			" "
Total		224	180	150	

Group C

①	A.P. 375	10.5 39	48 180		6-8 weeks of age
②	A.S. 244	20.5 50			Same as Group A
③	M.P. 250			60 150	" "
④	A.S. 244	20.5 50			" "
⑤	A.S. 244	20.5 50			" "
⑥	A.S. 268	20.5 55			" "
Total		244	180	150	

Group D

①	A.P. 375	10.5 39	48 180		6-8 weeks of age
②	A.S. 244	20.5 50			Same as Group A
③	M.P. 312			60 188	" "
④	A.S. 244	20.5 50			" "
⑤	A.S. 244	20.5 50			" "
⑥	A.S. 171	20.5 35			" "
Total		224	180	188	

Group E

①	R.R.P. 500		36 180		With seed
②	A.P. 375	10.5 39	48 180		6-8 weeks of age
③	A.S. 350	20.5 72			3 months of age
④	M.P. 250			60 150	3 " "
⑤	A.S. 350	20.5 72			6 " "
Total		183	360	150	

Group F

①	R.R.P. 500		36 180		With seed
②	A.P. 375	10.5 39	48 180		6-8 weeks of age
③	A.S. 244	20.5 50			3 months of age
④	M.P. 250			60 150	3 " "
⑤	A.S. 244	20.5 50			6 " "
⑥	A.S. 317	20.5 65			8-10 " "
Total		204	360	150	

Group G

①	R.R.P. 500		36 180		With seed
②	A.P. 375	10.5 39	48 180		Same as Group F
③	A.S. 244	20.5 50			" "
④	M.P. 250			60 150	" "
586	A.S. 244	20.5 50			" "
⑦	A.S. 171	20.5 35			" "
Total		224	360	150	

Group H

①	R.R.P. 500		36 180		With seed
②	A.P. 375	10.5 39	48 180		6-8 weeks of age
③	A.S. 244	20.5 50			Same as Group F
④	M.P. 312			60 188	" "
586	A.S. 244	20.5 50			" "
⑦	A.S. 171	20.5 35			" "
Total		224	360	188	

McBRYDE SUGAR CO.

Group I

①	A.P. 375	10.5 39	48 180		6-8 weeks of age
②	A.S. 350	20.5 72			3 months of age
③	M.P. 250			60 150	3 " "
④	A.S. 350	20.5 72			6 " "
	Total	183	180	150	

LEGEND

A - For fields low in P_2O_5 and medium low in K_2O, and not requiring as heavy N as B and C groups.

B - For fields low in P_2O_5 and medium low in K_2O, and requiring more N than A and less than C group.

C - For fields low in P_2O_5 and medium low in K_2O, and requiring maximum N.

D - For fields known to be low in K_2O and P_2O_5.

E - Plant fields requiring low N, on account of variety, or of receiving mudpress cake or manure. These fields low in P_2O_5 and medium low in K_2O, receive Raw Rock Phosphate as supplemental dose.

F - This group for plant fields which had less mudpress cake, if any, and requiring more N than E group.

G - Same as F group except require more N, plant fields.

H - Plant fields low in K_2O and P_2O_5.

I - Fields low in P_2O_5, medium low in K_2O, and not requiring much N, due to variety or growing time as S. R. etc.

HAWAIIAN SUGAR CO

For long ratoons when molasses ash is used

①	H.S.-3 343.75	13.25 45.55	33.4 114.8		Soon after start
②	Mol.Ash 350			115.71	In first water
③	A.S. 682.5	20.6 140.6			Applied in 3 or 4 doses
④	M.P. 133			60 79.8	With last appl. of A.S.
⑤	N.S. 400	16 64			In 2 doses not later than June
	Total	250	114.8	195.5	

For long ratoons where no molasses ash is used

①	H.S.-2 625	7.25 45.31	17.75 110.95	19.25 120.3	Soon after start
②	A.S. 682.5	20.5 140.6			Applied in 3 or 4 doses
③	M.P. 133			60 79.8	With last appl. of A.S.
④	N.S. 400	16 64			In 2 doses not later than June
	Total	250	111	200	

Short ratoons

①	H.S.-2 625	7.25 45.3	17.75 110.94	19.25 120.31	Soon after start
②	A.S. 400	20.6 82.4			In 2 doses just after High Grade application
③	N.S. 300	16 48			About middle of May not later than June
	Total	175.7	110.94	120.31	

Long ratoons - above Mill Ditch

①	H.S.-4 625	8 50	32 200	16 100	Soon after start
②	A.S. 450	20.5 92.7			In two applications - following High Grade
③	C.P.N. 715	15 107¼		14 100.1	Applied 3 or 4 doses not later than June
	Total	249.95	200	200.1	

Long ratoons - below Mill Ditch

①	H.S.-3 343.7	13.25 45.5	33.4 114.8		Soon after start
②	N.S. 937.5	16 150			In 5 or 6 applications, 3 in 2nd. season
	Total	195.5	114.8		

Short ratoons 1936 Crop

①	H.S.-3 343.7	13.25 45.5	33.40 114.8		Soon after start
②	C.P.N. 857	15 128.5		14 120	In 4 applications not later than June
	Total	174.1	114.8	120	

WAIMEA SUGAR MILL CO.

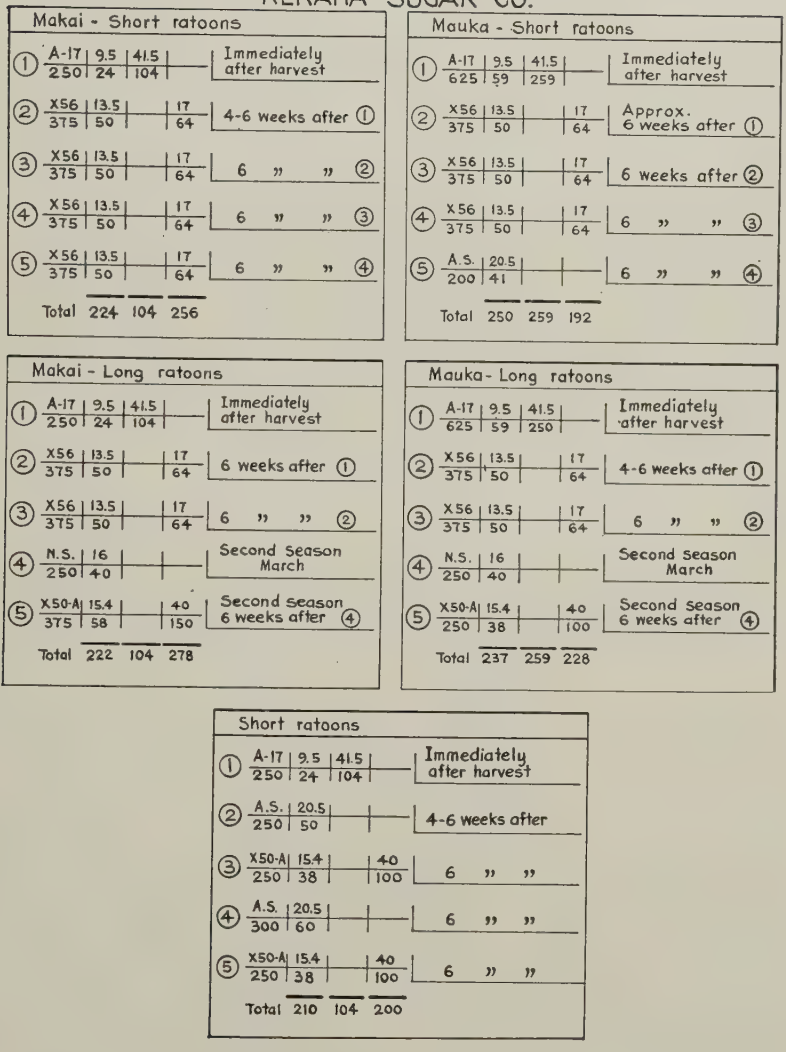
Short ratoons

①	A-17 250	9.5 23¾	41.5 103¾		Before first irrigation
②	N.S. 250	15.5 38¾			1 month after ①
③	X50-A 250	15.4 38.5		40 100	6 weeks after ②
④	N.S. 375	15.5 58.1			6 " " ③
⑤	X50-A 375	15.4 57¾		40 150	6 " " ④
	Total	216.85	103¾	250	

Long ratoons

①	A-17 250	9.5 23¾	41.5 103¾		After harvest
②	A.S. 200	20.5 41			1 month after ①
③	X50-A 250	15.4 38.5		40 100	6 weeks after ②
④	N.S. 250	15.5 38¾			Feb. or March
⑤	X50-A 250	15.4 38.5		40 100	6 weeks after ④
	Total	180.5	103¾	200	

KEKAHA SUGAR CO.



PIONEER MILL CO.

PLANT AND LONG RATOONS

General

①	A-17 500	9.5 47.5	41.5 207.5		April to August
②	N.P. 250	13.2 33		44.9 112.2	June to September
③	A.S. 350	20.8 72.8			August to November
④	A.S. 250	20.8 52			January to February
⑤	A.S. 250	20.8 52			February to March
Total		257.3	207.5	112.2	

Middle and Mauka fields not receiving mol.

①	A-19 750	6.7 50.2	29.25 219.4	16 120	April to August
②	A.S. 250	20.8 52			June to October
③	A.S. 250	20.8 52			August to November
④	A.S. 250	20.8 52			January to February
⑤	A.S. 250	20.8 52			February to March
Total		258.2	219.4	120	

Makai, receiving molasses and/or pump water

①	A-17 500	9.5 47.5	41.5 207.5		April to August
②	A.S. 250	20.8 52			June to October
③	A.S. 250	20.8 52			August to November
④	A.S. 250	20.8 52			January to February
⑤	A.S. 250	20.5 52			February to March
Total		255.5	207.5		

Makai, receiving molasses and/or pump water

①	A.P.A 500	11.1 55.5	49.2 246		April to August
②	A.S. 250	20.8 52			June to October
③	A.S. 250	20.8 52			August to November
④	A.S. 250	20.8 52			January to February
⑤	A.S. 250	20.8 52			February to March
Total		263.5	246		

SHORT RATOONS

Middle and Mauka fields not receiving mol.

①	A-19 750	6.7 50.2	29.25 219.4	16 120	December to March
②	A.S. 250	20.8 52			February to May
③	A.S. 250	20.8 52			April to July
④	A.S. 250	20.8 52			July to September
⑤	A.S. 250	20.8 52			July to October
Total		258.2	219.4	120	

Fields below Pump Ditches &/or fields receiving mol.

①	A-17 500	9.5 47.5	41.5 207.5		December to March
②	A.S. 250	20.8 52			February to May
③	A.S. 250	20.8 52			April to July
④	A.S. 250	20.8 52			June to September
⑤	A.S. 250	20.8 52			July to October
Total		255.5	207.5		

Middle belt, not receiving molasses

①	A-19 750	6.7 50.2	29.25 219.4	16 120	January to March
②	A.S. 250	20.8 52			February to May
③	A.S. 250	20.8 52			April to July
④	A.S. 250	20.8 52			June to September
⑤	A.S. 250	20.8 52			July to October
Total		258.2	219.4	120	

Makai, receiving molasses and/or pump water

①	A.P.A 500	11.1 55.5	49.2 246		January to March
②	A.S. 250	20.8 52			February to May
③	A.S. 250	20.8 52			April to July
④	A.S. 250	20.8 52			June to September
⑤	A.S. 250	20.8 52			July to October
Total		263.5	246		

PIONEER MILL CO.

PLANT AND LONG RATOONS
Middle belt fields not receiving molasses

①	A-19 / 750	6 7 / 50.2	29.25 / 219 4	16 / 120		April to August
②	A.S. / 250	20.8 / 52				June to October
③	A S / 250	20.8 / 52				August to November
④	A.S. / 250	20 8 / 52				January to February
⑤	A.S. / 250	20.8 / 52				February to March
Total		258.2	219.4	120		

SHORT RATOONS
Extreme Mauka conditions and "G" fields

①	A-19 / 750	6 7 / 50.2	29.25 / 219.4	16 / 120		January to March
②	A.S. / 250	20.8 / 52				February to May
③	X-35 / 250	22 / 55		29 / 72.5		April to July
④	A.S. / 250	20.8 / 52				June to September
⑤	A.S. / 250	20.8 / 52				July to October
Total		261.2	219.4	192.5		

PLANT AND LONG RATOONS
All extreme Mauka and "G" fields

①	A-19 / 750	6.7 / 50.2	29.25 / 219.4	16 / 120		April to August
②	A.S. / 250	20.8 / 52				June to October
③	C.P.N. / 375	14.4 / 54		18.79 / 70.46		August to November
④	A.S. / 250	20.8 / 52				January to February
⑤	A.S. / 250	20.8 / 52				February to March
Total		260.2	219.4	190.46		

MAUI AGRICULTURAL CO.

Early started fields up to and including February

①	A.P. / 200	11 / 22	48 / 96			As soon as possible after harvest. With seed
②	A.S. / 200	20.5 / 41.5				2 months of age
③	A.S. / 200	20.5 / 41.5				3 " "
④	A.S. / 200	20.5 / 41.5				5 " "
⑤	A.S. / 200	20.5 / 41.5				7 " "
⑥	A.S. / 250	20.5 / 52				February of the 2nd. year
Total		240	96			

Intermediate started fields - March to May inclusive

①	A.P. / 200	11 / 22	48 / 96			As soon as possible on ratoons. With seed
②	A.S. / 200	20.5 / 41.5				2 months of age
③	A.S. / 200	20.5 / 41.5				3 " "
④	A.S. / 200	20.5 / 41.5				4 " "
⑤	A.S. / 200	20.5 / 41.5				February
⑥	A.S. / 250	20.5 / 52				March or April
Total		240	96			

Late started fields - June, July and August

①	A.P. / 200	11 / 22	48 / 96			With seed Ratoons-2 wks. of age
②	A.S. / 250	20.5 / 52				Plant - 1 month of age
③	A.S. / 300	20.5 / 62				Age 2 months, but before Sept. 30.
④	A.S. / 250	20.5 / 52				February - 2nd. year
⑤	A.S. / 250	20.5 / 52				April - Second year
Total		240	96			

WAILUKU SUGAR CO.

Early started - First of December to end of February. POJ 2878 - 13 to 14 months.

①	A.S. 200	20.8 41			Rat. 3 wks. after harvest. Plant - 5-6 wks. after ptg.
	M.P. 250			60 150	If the field requires it
②	A.S. 200	20.8 41			1 month after ①
③	A.S. 250	20.8 52			2 months after ②
④	A.S. 200	20.8 41			2 " " ③
Total		175		150	

Early started - First of December to the end of February. H 109 - 18 to 20 months.

①	A.S. 200	20.8 41			Ratoons 3-4 weeks after harvest
	M.P. 250			60 150	If necessary
②	A.S. 200	20.8 41			1 month after ①
③	A.S. 300	20.8 62			3 months after ②
④	A.S. 300	20.8 62			2-3 " " ③
Total		206		150	

Intermediate started - March to May inclusive. POJ 2878 - 13 to 14 months.

①	A.S. 200	20.8 41			Rat. 3-4 wks. after harvest. Plant 5-6 wks. after Ptg.
	M.P. 250			60 150	If necessary
②	A.S. 200	20.8 41			1 month after ①
③	A.S. 250	20.8 52			2 months after ②
④	A.S. 200	20.8 41			2 " " ③
Total		175		150	

Intermediate started - April to July inclusive. H 109 - 18 to 20 months.

①	A.S. 200	20.8 41			Ratoons 3-4 weeks after harvest.
	M.P. 250			60 150	If field requires
②	A.S. 250	20.8 52			1 month after ①
③	A.S. 250	20.8 52			2-3 months after ②
④	A.S. 300	20.8 62			February
Total		206		150	

Very late - September to November inclusive. POJ 2878 - 13 to 14 months.

①	A.S. 200	20.8 41			Rat. 3 wks. after harvest Plant 4-5 wks. after ptg.
	M.P. 250			60 150	If necessary
②	A.S. 200	20.8 41			1 month after ①
③	A.S. 250	20.8 52			February to March
④	A.S. 200	20.8 41			March to April
Total		175		150	

Late crop started August to November inclusive. H 109 - 18 to 20 months.

①	A.S. 200	20.8 41			Ratoons 2-3 weeks after harvest.
	M.P. 250			60 150	If necessary
②	A.S. 200	20.8 41			Not more than 1 month after ①
③	A.S. 300	20.8 62			February to March
④	A.S. 300	20.8 62			April to May
Total		206		150	

Late crop - June to August inclusive. POJ 2878 - 13 to 14 months.

①	A.S. 200	20.8 41			Rat. 3 wks. after harvest Plant 4-5 wks. after ptg.
	M.P. 250			60 150	If field requires
②	A.S. 250	20.8 52			1 month after ①
③	A.S. 200	20.8 41			January to February
④	A.S. 200	20.8 41			February to March
Total		175		150	

Note :-
For fields requiring P_2O_5 - substitute 375# applic of Ammophos (11% N - 49% P_2O_5) for first A.S. applic (184# P_2O_5)

H.C.& S. CO.

Long ratoons. Early started - Mauka fields or those receiving mountain water only

①	G-2 630	4 25	28 176.5	16 101		After first water
②	A.S. 200	20.5 41				On before end of June
③	A.S. 200	20.5 41				
④	A.S. 200	20.5 41				On by end of Sept.
⑤	A.S. 200	20.5 41				January
⑥	N.S. 350	15.5 54				March
Total		243	176.5	101		

Long crop. Early started All fields receiving pump water

①	A.P. 350	10.7 37.5	49.5 173			Plant - as soon as it is up Rat. - as soon as possible Applied after irrigation
②	A.S. 200	20.5 41				Before end of June
③	A.S. 200	20.5 41				
④	A.S. 200	20.5 41				On by end of Sept.
⑤	A.S. 200	20.5 41				January
⑥	N.S. 350	15.5 54				March
Total		255	173			

Short ratoons. Makai fields or those receiving mountain water only

①	G-2 630	4 25	28 176.5	16 101		After first water-covered
②	A.S. 200	20.5 41				
③	A.S. 200	20.5 41				
④	A.S. 200	20.5 41				
⑤	A.S. 200	20.5 41				
⑥	A.S. 200	20.5 41				All on by end of Sept.
Total		230	176.5	101		

Short ratoons. All fields receiving pump water

①	A.P. 350	10.7 37.5	49.5 173			As soon as possible after first irrigation when ground is wet
②	A.S. 200	20.5 41				
③	A.S. 200	20.5 41				
④	A.S. 200	20.5 41				
⑤	A.S. 200	20.5 41				
⑥	A.S. 200	20.5 41				All on by end of Sept.
Total		242	173			

Long crop. Late started. All fields

①	A.P. 350	10.7 37	49.8 173			Plant - as soon as it is up Rat. - as soon as possible Applied after irrigation
②	A.S. 200	20.5 41				
③	A.S. 200	20.5 41				On by end of September
④	A.S. 200	20.5 41				January
⑤	N.S. 350	15.5 54				March
Total		214	173			

WAIMANALO SUGAR CO.

Fields high in Phosphate

①	C.P.N. 625	15 93.7		13.5 84.4	Immediately after harvest
②	C.P.N. 625	15 93.7		13.5 84.4	Within 3 months
	Total	187.4		168.8	

Plant fields low in Phosphate & Potash

①	R.R.P. 500		36 180		With seed
②	C.P.N. 500	15 75		13.5 67.5	1 month after ①
③	C.P.N. 700	15 105		13.5 94.5	" " ②
	Total	180	180	162	

Ratoon fields low in Phosphate & Potash

①	Di.A.P. 250	20.4 50	45.7 112.5		Immediately after harvest
	C.P.N. 325	15 56.3		13.5 50.6	
②	C.P.N. 500	15 75		13.5 67.5	3 months after ①
	Total	181.3	112.5	118.1	

Fields high in Phosphate and Potash

①	N.S. 625	15.5 97			Immediately after harvest
②	N.S. 625	15.5 97			3 months after ①
	Total	194			

KAHUKU PLANTATION CO.

Short ratoons

①	A.P. 450	16.5 74	20 90		Right after harvest
	M.P. 150			60 90	" "
②	A.S. 350	20.5 72			2 months after ①
	Total	146	90	90	

Long ratoons

①	A.P. 500	16.5 82.5	20 100		Right after harvest
	M.P. 175			60 105	" "
②	A.S. 150	20.5 31			2 months after ①
③	A.S. 300	20.5 61.5			Spring of the Second year
	Total	175	100	105	

WAIANAE CO.

Long ratoons

①	A-21 500	5 25	20 100	20 100	2 wks. after harvest
②	A.S. 250	20.5 51.5			2 months after ①
③	A.S. 250	20.5 51.5			" " ②
④	C.P.N. 200	14.6 29		14 28	" " ③
⑤	C.P.N. 500	14.6 73		14 70	2nd. Season
	Total	230	100	198	

Short ratoons

①	A-15 500	9 45	20 100	20 100	Right after harvest
②	A.S. 250	20.5 51.5			2 months after ①
③	A.S. 250	20.5 51.5			" " ②
④	Urea/NP 375	82.5		108	June or July of the first year
	Total	230.5	100	208	

WAIALUA AGRICULTURAL CO.

Long ratoons - Started in Jan., Feb. or March

①	A.S. 250	20.5 51			1 or 2 months after harvest
②	A.P. 300	10.5 32	49 147		Soon after ①
③	M.P. 100			60 60	" " ②
④	A.S. 400	20.5 82			1½ months after ③
⑤	A.S. 200	20.5 41			February of 2nd. year
⑥	A.S. 200	20.5 41			March of 2nd. year
Total		247	147	60	

Long ratoons - Started in April or May

①	A.S. 500	20.5 103			As soon as possible
②	A.P. 400	10.5 42	49 196		Soon after ①
③	M.P. 125			60 75	" " ②
④	A.S. 250	20.5 51			February of 2nd. year
⑤	A.S. 250	20.5 51			April of 2nd. year
Total		247	196	75	

Long ratoons - Started in June or July

①	A.S. 400	20.5 82			As soon as possible
②	A.P. 400	10.5 42	49 196		" "
③	M.P. 125			60 75	Soon after ②
④	A.S. 300	20.5 62			February of 2nd. year
⑤	A.S. 300	20.5 62			April or May of 2nd. year
Total		248	196	75	

Long ratoons - Started in August

①	A.S. 350	20.5 72			As soon as possible
②	A.P. 300	10.5 32	49 147		" "
③	M.P. 125			60 75	Soon after ②
④	A.S. 350	20.5 72			February of 2nd. year
⑤	A.S. 350	20.5 72			May of 2nd. year
Total		248	147	75	

Plant

①	Super 500		20.5 103		With seed
②	A.S. 300	20.5 62			2 months after planting
③	M.P. 125			60 75	Soon after ②
④	A.S. 400	20.5 82			1 - 2 months after ②
⑤	A.S. 250	20.5 51			February of 2nd. year
⑥	A.S. 250	20.5 51			March of 2nd. year
Total		246	103	75	

EWA PLANTATION CO.

I — For Lands that get no Potash (12% of the plantation)

Long Ratoons — Started April, May, June and July

①	A.S. 275	20.5 56				6 wks. after harvest
②	A.S. 500	20.5 102.5				7 wks. after ①
③	N.L. * 500	15.5 77.5				8 wks. after ② or 2nd. season
Total	236					

Long Plant: Started any time — Long Ratoons: Started after Aug. 15

①	A.S. 275	20.5 56				6 wks. after harvest. 12 wks. or after planting.
②	A.S. 500	20.5 102.5				2nd. season
③	N.L. * 500	15.5 77.5				" "
Total	236					

II — For Lands that get 75 to 125 lbs. Potash per acre

Long Ratoons — Started April, May, June and July

①	A.S. 300	20.5 61.5				6 wks. after harvest
②	A.S. 500	20.5 102.5				8 wks. after ①
③	C.P.N. 525	14.5 76		14	73.5	8 wks. after or 2nd. season
Total	240			73.5		

Long Plant: Started any time — Long Ratoons: Started after Aug. 15

①	A.S. 300	20.5 61.5				Same notes as above
②	A.S. 500	20.5 102.5				"
③	C.P.N. 525	14.5 76		14	73.5	"
Total	240			73.5		

(20% of the plantation)

(For insurance only) Low in K_2O based on juice analysis

Long Ratoons — Started April, May, June and July

①	A.S. 275	20.5 56				Same notes as above
②	C.P.N. 700	14.5 101.5		14	98	"
③	N.L. 500	15.5 77.5				"
Total	235			98		

Long Plant: Started any time — Long Ratoons: Started after Aug. 15

①	A.S. 275	20.5 56				Same notes as above
②	C.P.N. 700	14.5 101.5		14	98	"
③	N.L. 500	15.5 77.5				"
Total	235			98		

III — For Lands that get 200 to 250 lbs. Potash per acre (58% of the plantation)

Long Ratoons — Started April, May, June and July

①	A.S. 275	20.5 56				6 wks after harvest
②	A.S. 500	20.5 101.5				8 wks. after ①
③	M.P. 400			60	240	In water at 5 months
④	N.L. 500	15.5 77.5				8 wks. after ③ or 2nd. season
Total	235			240		

Long Plant: Started any time — Long Ratoons: Started after Aug. 15

①	A.S. 275	20.5 56				Same notes as above
②	A.S. 500	20.5 101.5				"
③	M.P. 400			60	240	"
④	N.L. 500	15.5 77.5				"
Total	235			240		

IV — For Lands that get 300 to 400 lbs. Potash per acre (10% of the plantation)

Long ratoons and long plant

①	A.S. 275	20.5 56				
②	A.S. 500	20.5 101.5				
③	M.P. 625			60	375	
④	N.L. 500	15.5 77.5				
Total	235			375		

Long ratoons

①	A.S. 275	20.5 56				
②	A.S. 500	20.5 101.5				
③	M.P. 625			60	375	
④	A.S. 375	20.5 77.5				
Total	235			375		

* N.L. used in place of N.S. on all wet fields. A.S. used in place of N.L. on all coral fields. This applies throughout.

If 8 weeks later comes after the middle of October, application is postponed to Spring of 2nd. year

Note:- All fertilizer applied by hand, size and condition of cane permitting. 2nd.-season fertilizer applied in water. Owing to lower efficiency of water vs. hand application, the total application of N is increased by 25 pounds per acre when water application employed.

Note:- A.P. (10.7% N - 48% P_2O_5) used on fields low in P_2O_5 in place of A.S. in ① application.

EWA PLANTATION CO.

	SHORT RATOONS			SHORT PLANT
	Started Jan.	Started Feb.	Started Mar.	Started Jan. & Feb.
I For Lands that get no Potash (12% of the plantation) →	① A.S.* 275 | 20.5 56 — 10 wks. after harvest ② N.L.* 800 | 15.5 124 — 7 wks. after ①	8 wks. after harvest 7 wks. after ①	7 wks. after harvest 7 wks. after ①	12 wks. after planting 7 wks. after ①
	Total 180			
II For Lands that get 75 to 125 lbs. Potash per acre (20% of the plantation) → (For insurance only)	① A.S. 275 | 20.5 56 ② C.P.N. 900 | 14.5 130.5 — 14 126	"	"	"
	Total 186.5 — 126			
III For Lands that get 200 to 250 lbs. Potash per acre (58% of the plantation →	① A.S.* 275 | 20.5 56 ② A.S. 600 | 20.5 123 ③ M.P. 400 — 60 240 — In water at 5 months	"	"	"
	Total 179 — 240			
IV For Lands that get 300 to 400 lbs. Potash per acre (10% of the plantation) →	**Good Soils and Wet Soils**			
	① N.L. 350 | 15.5 54 ② N.L. 800 | 15.5 124 ③ M.P. 675 — 60 405	"	"	"
	Total 178 — 405			
	Coral Lands			
	① A.S. 275 | 20.5 56 ② A.S. 600 | 20.5 123 ③ M.P. 675 — 60 405	"	"	"
	Total 179 — 405			

OAHU SUGAR CO.

Early start - December, January & February

①	A-14 400	7 28	20.5 82	17 68	As soon as possible
②	A-14 700	7 49	20.5 143.5	17 119	8-12 weeks after ①
③	A.S. 500	20.5 102.5			May or July
④	N.S. 625	15.5 97			2nd. Season
	Total	276.5	225.5	187	

Late start (After May 15)

①	A-14 1100	7 77	20.5 225.5	17 187	As soon as possible
②	A.S. 350	20.5 71.8			July
③	N.S. 500	15.5 77.5			2nd. Season February or March
④	N.S. 375	15.5 58			2nd. season (April)
	Total	284.3	225.5	187	

Intermediate (March, April and May)

①	A-14 400	7 28	20.5 82	17 68	As soon as possible
②	A-14 700	7 49	20.5 143.5	17 119	4-8 weeks after ①
③	A.S. 350	20.5 71.8			June or July
④	N.S. 500	15.5 77.5			2nd. season
⑤	N.S. 375	15.5 58			" "
	Total	284.3	225.5	187	

Plant cane

①	A-14 500	7 35	20.5 102.5	17 85	With seed
②	A-14 600	7 42	20.5 123	17 102	8-12 weeks after ①
③	A.S. 300	20.5 61			May or June
④	N.S. 500	15.5 77.5			2nd. season
⑤	N.S. 375	15.5 58			" "
	Total	273.5	225.5	187	

HONOLULU PLANTATION CO.

For low P_2O_5 and K_2O requirements For H109 cane under 18 months cropping

①	A 406	10.5 43	20.5 83	12.8 52	With seed Ratoons with subsoiling
②	A.S. 300	20.5 61.5			Following irrigation after subsoiling
③	A.S. 300	20.5 61.5			Following 2nd. irrigation after subsoiling
④	A.S. 400	20.5 82			1 year after harvest
	Total	248	83	52	

For low P_2O_5 and K_2O requirements For POJ 2878 under 12 months cropping

①	A 406	10.5 43	20.5 83	18.8 76	With seed Ratoons with subsoiling
②	A.S. 200	20.5 41			Following irrigation after subsoiling
③	A.S. 200	20.5 41			Following 2nd. irrigation after subsoiling
④	A.S. 200	20.5 41			1 month after ③
	Total	166	83	76	

Low P_2O_5 and medium K_2O requirements For H109 cane under 18 months cropping

①	B 531	8 42.5	19.4 103	24.3 129	Same notes as above
②	A.S. 300	20.5 61.5			" "
③	A.S. 300	20.5 61.5			" "
④	A.S. 400	20.5 82			" "
	Total	247.5	103	129	

Low P_2O_5 and medium K_2O requirements. For POJ 2878 under 12 months cropping

①	B 531	8 42.5	19.4 103	24.3 129	Same notes as above
②	A.S. 200	20.5 41			" "
③	A.S. 200	20.5 41			" "
④	A.S. 200	20.5 41			" "
	Total	165.5	103	129	

HONOLULU PLANTATION CO.

For low P_2O_5 and K_2O requirements
For H109 cane under 18 months cropping

①	C 625	6.7 42	32 200	20 125	With seed Ratoons with subsoiling
②	A.S. 300	20.5 61.5			Following irrigation after subsoiling
③	A.S. 300	20.5 61.5			Following 2nd. irrigation after subsoiling
④	A.S. 400	20.5 82			1 year before harvest
Total		247	200	125	

For low P_2O_5 and K_2O requirements
For POJ 2878 under 12 months cropping

①	C 625	6.7 42	32 200	20 125	With seed Ratoons with subsoiling
②	A.S. 200	20.5 41.5			Following irrigation after subsoiling
③	A.S. 200	20.5 41.5			Following 2nd. irrigation after subsoiling
④	A.S. 200	20.5 41.5			1 month after ③
Total		166.5	200	125	

For medium P_2O_5 and high K_2O requirements
For H109 cane under 18 months cropping

①	D 750	5.6 42	26.7 200	26.7 200	Same notes as above
②	A.S. 300	20.5 61.5			" "
③	A.S. 300	20.5 61.5			" "
④	A.S. 400	20.5 82			" "
Total		247	200	200	

For medium P_2O_5 and high K_2O requirements
For POJ 2878 under 12 months cropping

①	D 750	5.6 42	26.7 200	26.7 200	Same notes as above
②	A.S. 200	20.5 41			" "
③	A.S. 200	20.5 41			" "
④	A.S. 200	20.5 41			" "
Total		165	200	200	

For high P_2O_5 and high K_2O requirements
For H109 cane under 18 months cropping

①	E 1000	4.1 41	30 300	20 200	Same notes as above
②	A.S. 300	20.5 61.5			" "
③	A.S. 300	20.5 61.5			" "
④	A.S. 400	20.5 82			" "
Total		246	300	200	

For high P_2O_5 and high K_2O requirements
For POJ 2878 under 12 months cropping

①	E 1000	4.1 41	30 300	20 200	Same notes as above
②	A.S. 200	20.5 41			" "
③	A.S. 200	20.5 41			" "
④	A.S. 200	20.5 41			" "
Total		164	300	200	

For high P_2O_5 and medium K_2O requirements
For H109 cane under 18 months cropping

①	F 875	4.8 42	34.4 301	14.3 125	Same notes as above
②	A.S. 300	20.5 61.5			" "
③	A.S. 300	20.5 61.5			" "
④	A.S. 400	20.5 82			" "
Total		247	301	125	

For high P_2O_5 and medium K_2O requirements
For POJ 2878 under 12 months cropping

①	F 875	4.8 42	34.4 301	14.3 125	Same notes as above
②	A.S. 200	20.5 41			" "
③	A.S. 200	20.5 41			" "
④	A.S. 200	20.5 41			" "
Total		165	301	125	

HONOLULU PLANTATION CO.

For poorly drained fields - low in P_2O_5 and low in K_2O requirements.
For H 109 cane under 18 months cropping

①	G 595	7.1 42	17 101	8.6 51	With seed Ratoon with subsoiling
②	N.L. 400	15.5 62			Following irrigation after subsoiling
③	N.L. 400	15.5 62			Following 2nd. irrigation after subsoiling
④	N.L. 550	15.5 85			1 year before harvest
Total		251	101	51	

For poorly drained fields - low in P_2O_5 and low in K_2O requirements
For POJ 2878 under 12 months cropping

①	G 250	7.1 18	17 42.5	8.6 21.5	With seed Ratoon with subsoiling
②	N.L. 250	15.5 39			Following irrigation after subsoiling
③	N.L. 250	15.5 39			Following 2nd. irrigation after subsoiling
④	N.L. 250	15.5 39			1 month after ③
Total		135	42.5	21.5	

For poorly drained fields - low in P_2O_5 and low in K_2O requirements
For H 109 cane under 18 months cropping

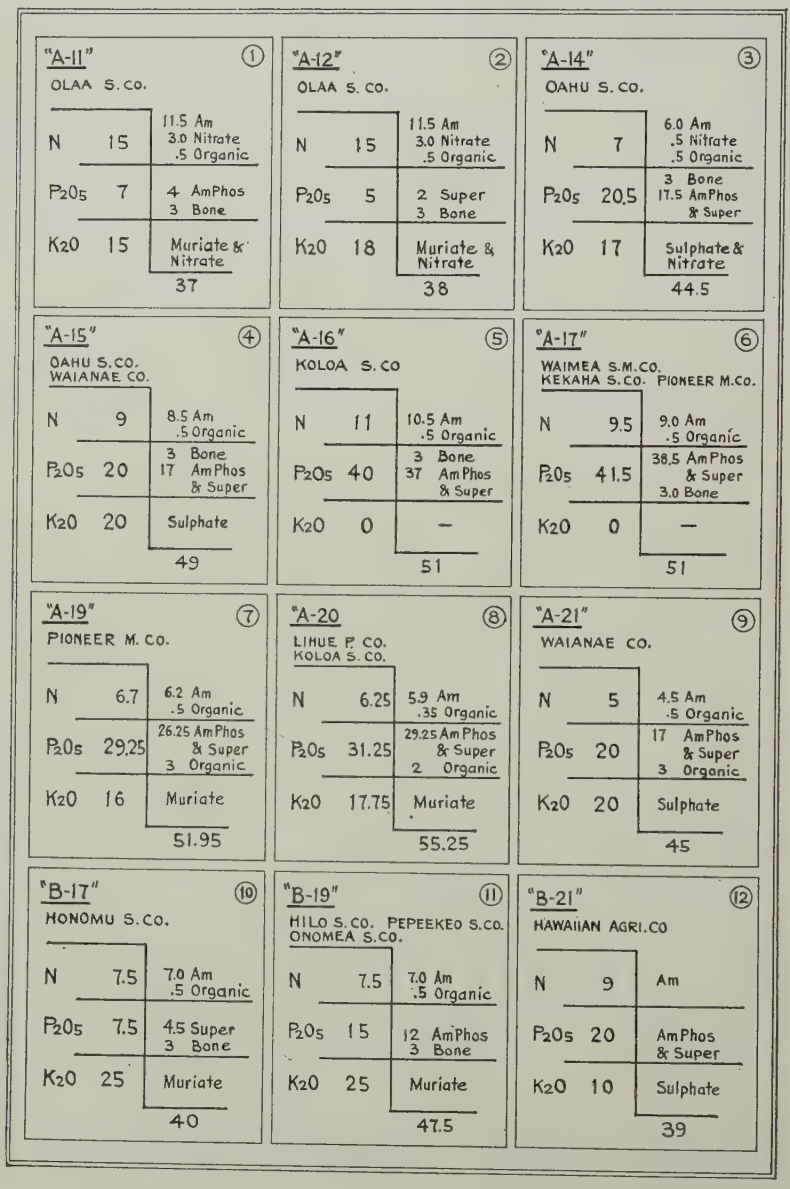
①	H 844	4.9 41	12 101	23.8 201	Same notes as above
②	N.L. 400	15.5 62			" "
③	N.L. 400	15.5 62			" "
④	N.L. 550	15.5 85			" "
Total		250	101	201	

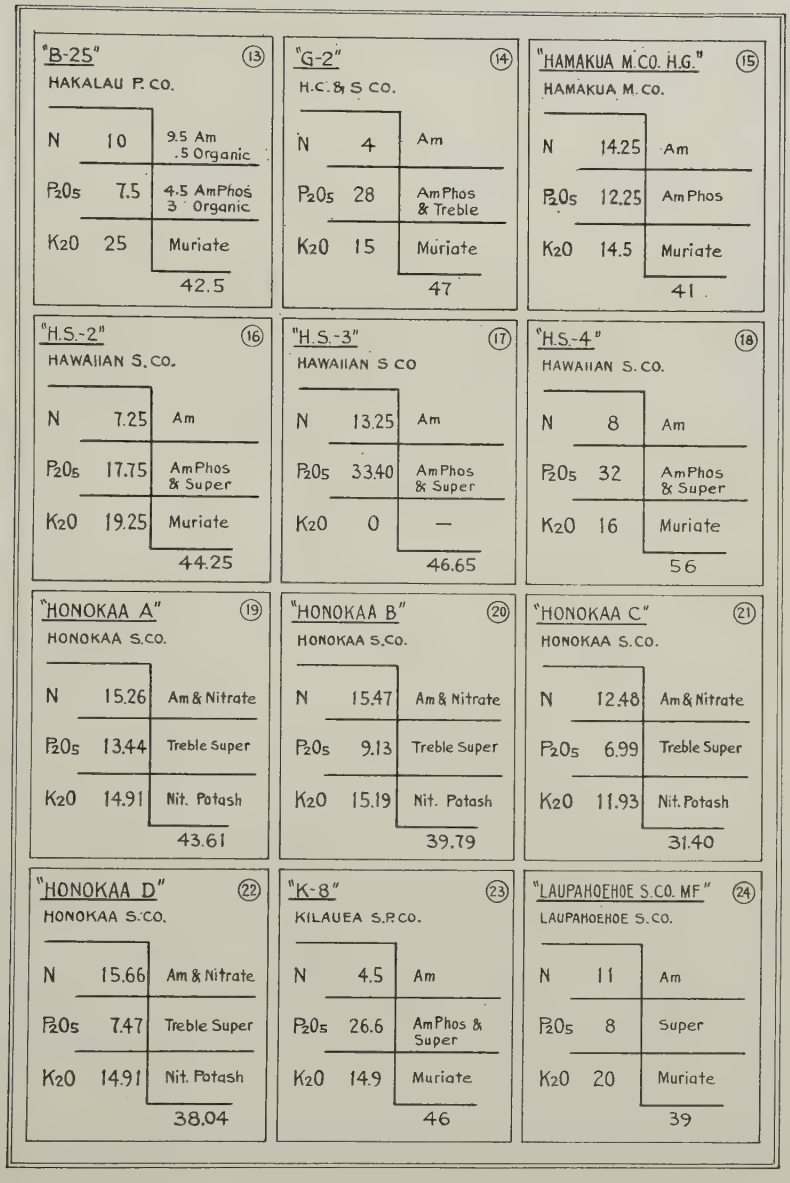
For poorly drained fields - low in P_2O_5 and low in K_2O requirements
For POJ 2878 under 12 months cropping

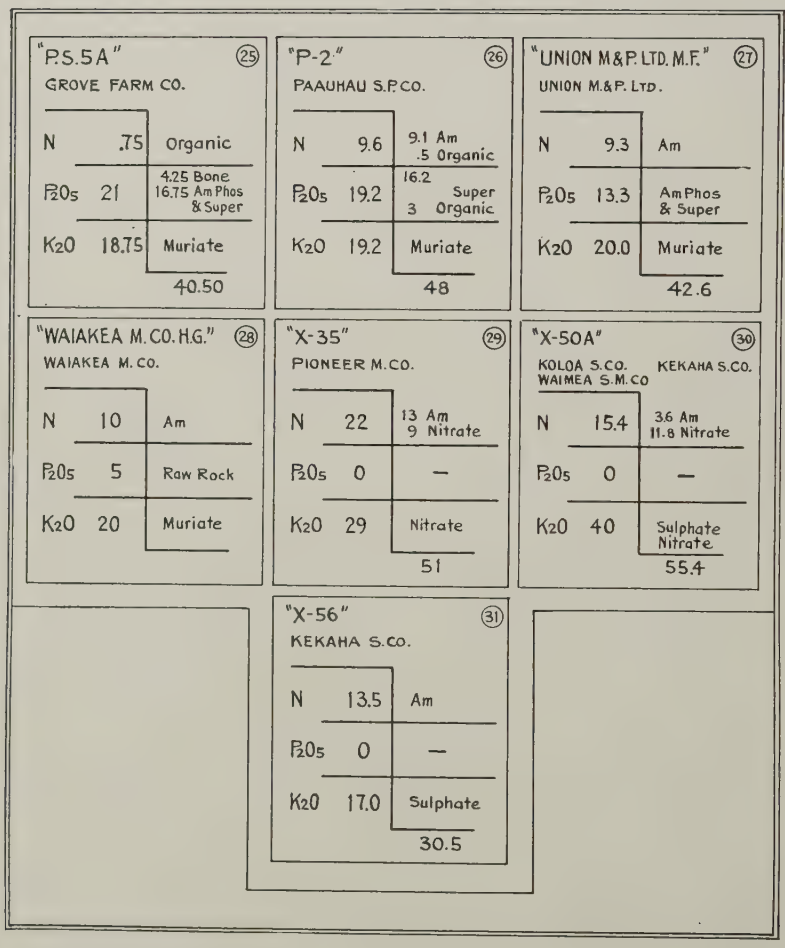
①	H 844	4.9 41	12 101	23.8 201	Same notes as above
②	N.L. 400	15.5 62			" "
③	N.L. 400	15.5 62			" "
④	N.L. 550	15.5 85			" "
Total		250	101	201	

FERTILIZER FORMULA CHART

Plantation	Formula	Block No.
Grove Farm Co., Ltd.	PS5A	25
Hakalau Plantation Co.	B-25	13
Hamakua Mill Company	Hamakua M. F.	15
Hawaiian Agricultural Company	B-21	12
Hawaiian Commercial & Sugar Company	G-2	14
Hawaiian Sugar Company	H. S. 2	16
	H. S. 3	17
	H. S. 4	18
Hilo Sugar Company	B-19	11
Honokaa Sugar Company	Honokaa A	19
	Honokaa B	20
	Honokaa C	21
	Honokaa D	22
Honomu Sugar Company	B-17	10
Kekaha Sugar Company, Ltd.	A-17	6
	X50A	30
	X56	31
Kilauea Sugar Plantation Company	K-8	23
Koloa Sugar Company	A-16	5
	A-20	8
	X50A	30
Laupahoehoe Sugar Company	Laupahoehoe	24
Lihue Plantation Company, Ltd.	A-20	8
Oahu Sugar Company, Ltd.	A-14	3
	A-15	4
Olaa Sugar Company, Ltd.	A-11	1
	A-12	2
Onomea Sugar Company	B-19	11
Paauhau Sugar Plantation Company	P-2	26
Pepeekeo Sugar Company	B-19	11
Pioneer Mill Company	A-17	6
	A-19	7
	X-35	29
Union Mill and Plantation, Ltd.	Union M. F.	27
Waiakea Mill Company	Waiakea M. F.	28
	10-5-20	
Waianae Company	A-15	4
	A-21	9
Waimea Sugar Mill Company	A-17	6
	X-50 A	30


"A-11" ①
OLAA S. CO.
N 15 | 11.5 Am 3.0 Nitrate .5 Organic
P2O5 7 | 4 AmPhos 3 Bone
K2O 15 | Muriate & Nitrate
37
"A-12" ②
OLAA S. CO.
N 15 | 11.5 Am 3.0 Nitrate .5 Organic
P2O5 5 | 2 Super 3 Bone
K2O 18 | Muriate & Nitrate
38
"A-14" ③
OAHU S. CO.
N 7 | 6.0 Am .5 Nitrate .5 Organic
P2O5 20.5 | 3 Bone 17.5 AmPhos & Super
K2O 17 | Sulphate & Nitrate
44.5
"A-15" ④
OAHU S.CO. WAIANAE CO.
N 9 | 8.5 Am .5 Organic
P2O5 20 | 3 Bone 17 AmPhos & Super
K2O 20 | Sulphate
49
"A-16" ⑤
KOLOA S. CO
N 11 | 10.5 Am .5 Organic
P2O5 40 | 3 Bone 37 AmPhos & Super
K2O 0 | —
51
"A-17" ⑥
WAIMEA S.M.CO. KEKAHA S.CO. PIONEER M.CO.
N 9.5 | 9.0 Am .5 Organic
P2O5 41.5 | 38.5 AmPhos & Super 3.0 Bone
K2O 0 | —
51
"A-19" ⑦
PIONEER M. CO.
N 6.7 | 6.2 Am .5 Organic
P2O5 29.25 | 26.25 AmPhos & Super 3 Organic
K2O 16 | Muriate
51.95
"A-20 ⑧
LIHUE P. CO. KOLOA S. CO.
N 6.25 | 5.9 Am .35 Organic
P2O5 31.25 | 29.25 AmPhos & Super 2 Organic
K2O 17.75 | Muriate
55.25
"A-21" ⑨
WAIANAE CO.
N 5 | 4.5 Am .5 Organic
P2O5 20 | 17 AmPhos & Super 3 Organic
K2O 20 | Sulphate
45
"B-17" ⑩
HONOMU S. CO.
N 7.5 | 7.0 Am .5 Organic
P2O5 7.5 | 4.5 Super 3 Bone
K2O 25 | Muriate
40
"B-19" ⑪
HILO S. CO. PEPEEKEO S. CO. ONOMEA S. CO.
N 7.5 | 7.0 Am .5 Organic
P2O5 15 | 12 AmPhos 3 Bone
K2O 25 | Muriate
47.5
"B-21" ⑫
HAWAIIAN AGRI. CO
N 9 | Am
P2O5 20 | AmPhos & Super
K2O 10 | Sulphate
39


"B-25" (13)
HAKALAU P. CO.
N 10 9.5 Am .5 Organic
P2O5 7.5 4.5 AmPhos 3 Organic
K2O 25 Muriate
42.5
"G-2" (14)
H.C. & S CO.
N 4 Am
P2O5 28 AmPhos & Treble
K2O 15 Muriate
47
"HAMAKUA M.CO. H.G." (15)
HAMAKUA M. CO.
N 14.25 Am
P2O5 12.25 AmPhos
K2O 14.5 Muriate
41
"H.S.-2" (16)
HAWAIIAN S. CO.
N 7.25 Am
P2O5 17.75 AmPhos & Super
K2O 19.25 Muriate
44.25
"H.S.-3" (17)
HAWAIIAN S CO
N 13.25 Am
P2O5 33.40 AmPhos & Super
K2O 0 —
46.65
"H.S.-4" (18)
HAWAIIAN S. CO.
N 8 Am
P2O5 32 AmPhos & Super
K2O 16 Muriate
56
"HONOKAA A" (19)
HONOKAA S.CO.
N 15.26 Am & Nitrate
P2O5 13.44 Treble Super
K2O 14.91 Nit. Potash
43.61
"HONOKAA B" (20)
HONOKAA S.CO.
N 15.47 Am & Nitrate
P2O5 9.13 Treble Super
K2O 15.19 Nit. Potash
39.79
"HONOKAA C" (21)
HONOKAA S.CO.
N 12.48 Am & Nitrate
P2O5 6.99 Treble Super
K2O 11.93 Nit. Potash
31.40
"HONOKAA D" (22)
HONOKAA S.CO.
N 15.66 Am & Nitrate
P2O5 7.47 Treble Super
K2O 14.91 Nit. Potash
38.04
"K-8" (23)
KILAUEA S.P.CO.
N 4.5 Am
P2O5 26.6 AmPhos & Super
K2O 14.9 Muriate
46
"LAUPAHOEHOE S.CO. MF" (24)
LAUPAHOEHOE S.CO.
N 11 Am
P2O5 8 Super
K2O 20 Muriate
39


"P.S.5A" (25)
GROVE FARM CO.
N .75 Organic
P2O5 21 4.25 Bone 16.75 Am Phos & Super
K2O 18.75 Muriate
40.50
"P-2" (26)
PAAUHAU S.P.CO.
N 9.6 9.1 Am .5 Organic
P2O5 19.2 16.2 Super 3 Organic
K2O 19.2 Muriate
48
"UNION M&P. LTD. M.F." (27)
UNION M.&P. LTD.
N 9.3 Am
P2O5 13.3 Am Phos & Super
K2O 20.0 Muriate
42.6
"WAIAKEA M. CO. H.G." (28)
WAIAKEA M. CO.
N 10 Am
P2O5 5 Raw Rock
K2O 20 Muriate
"X-35" (29)
PIONEER M.CO.
N 22 13 Am 9 Nitrate
P2O5 0 —
K2O 29 Nitrate
51
"X-50A" (30)
KOLOA S.CO. KEKAHA S.CO.
WAIMEA S.M.CO
N 15.4 3.6 Am 11.8 Nitrate
P2O5 0 —
K2O 40 Sulphate Nitrate
55.4
"X-56" (31)
KEKAHA S.CO.
N 13.5 Am
P2O5 0 —
K2O 17.0 Sulphate
30.5

Sugar Prices

96° CENTRIFUGALS FOR THE PERIOD
SEPTEMBER 19, 1934, TO DECEMBER 14, 1934.

Date	Per Pound	Per Ton	Remarks
Sept. 19, 1934	2.865¢	$57.30	Cubas, 2.86, 2.87.
" 20	2.865	57.30	Cubas, 2.86, 2.87.
" 21	2.87	57.40	Cubas.
" 24	2.885	57.70	Cubas, 2.87, 2.90.
" 25	2.90	58.00	Cubas.
" 26	2.91	58.20	Cubas, 2.92, 2.90.
" 27	2.94	58.80	Cubas.
" 28	2.96	59.20	Cubas, 2.95, 2.97.
Oct. 1	2.99	59.80	Cubas, 2.98, 3.00.
" 2	3.00	60.00	Cubas.
" 4	2.9833	59.67	Cubas, 2.95, 2.98, 3.02.
" 5	2.93	58.60	Cubas.
" 8	2.93	58.60	Cubas.
" 15	2.95	59.00	Cubas.
" 17	2.905	58.10	Cubas, 2.90, 2.91.
" 18	2.89	57.80	Cubas.
" 22	2.82	56.40	Cubas, 2.79, 2.85.
" 29	2.81	56.20	Puerto Ricos, Cubas, 2.80; Cubas, 2.81, 2.82.
Nov. 7	2.86	57.20	Cubas.
" 16	2.92	58.40	Cubas.
" 19	3.00	60.00	Cubas.
" 20	3.085	61.70	Cubas.
" 30	2.80	56.00	Cubas.
Dec. 5	2.9375	58.75	Cubas, 2.90, 2.975.
" 6	2.975	59.50	Cubas.
" 13	2.63	52.60	Cubas.
" 14	2.63	52.60	Cubas.

CIRCULAR NO. 64

EXPERIMENT STATION

OF THE

HAWAIIAN SUGAR PLANTERS' ASSOCIATION

Annual Synopsis of Mill Data 1934

BY

W. L. McCLEERY

HONOLULU, HAWAII
DECEMBER, 1934

TABLE NO. 1

VARIETIES OF CANE

Comprising One per cent or More of Total Crop

	H 109	Y. C.	D 1135	POJ 36	POJ 2878	Yellow Tip	K 202	Badila	K 107	Striped Tip	H. Uba	Others	
H. C. & S. Co.	100	....	....	....	....	....	....	....	....	....	....	....	
Oahu	98	....	....	....	....	....	....	....	....	....	....	2	
Ewa	99	....	....	....	....	....	....	....	....	....	....	1	
Waialua	93	....	1	....	2	....	....	....	....	....	....	4	
Maui Agr.	100	....	....	....	....	....	....	....	....	....	....	....	
Pioneer	94	....	1	1	2	....	....	....	....	....	....	2	
Lihue	45	....	2	16	1	15	4	8	....	....	....	9	
Olaa	....	67	22	11	....	....	....	....	....	....	....	....	
Haw. Sug.	97	....	1	....	2	....	....	....	....	....	....	....	
Kekaha	97	....	....	....	....	1	....	....	....	....	....	2	
Honolulu	92	....	....	2	5	....	....	....	....	....	....	1	
Haw. Agr.	....	14	73	....	....	....	....	....	....	....	....	13	(1)
Onomea	....	57	3	35	....	2	....	....	....	....	....	3	
Hilo	....	79	10	7	2	....	....	....	....	....	....	2	
Honokaa	....	....	59	12	4	....	....	....	....	....	20	5	
Makee	53	10	....	7	1	2	2	3	....	....	....	22	(2)
McBryde	65	....	5	6	18	....	2	....	....	....	....	4	
Wailuku	69	....	1	4	24	....	....	....	....	....	....	2	
Kahuku	80	....	....	....	10	....	5	....	....	....	....	5	
Hakalau	....	52	23	19	1	....	....	....	....	....	....	5	
Laupahoehoe	....	22	70	4	1	1	....	....	....	....	....	2	
Waiakea	....	95	2	1	....	....	....	....	....	....	....	2	
Koloa	57	1	....	14	1	20	5	....	....	....	....	2	
Hutchinson	....	9	68	19	1	....	....	....	....	....	....	3	
Hawi Mill	2	....	3	5	5	....	22	....	30	32	....	1	
Hamakua	....	5	71	3	....	7	....	....	....	1	1	12	(3)
Pepeekeo	....	81	2	16	....	....	1	....	....	....	....	....	
Paauhau	....	....	29	31	3	7	....	....	....	....	1	29	(4)
Kohala Mill	1	....	1	5	5	....	29	....	50	8	1	....	
Honomu	....	38	12	42	2	....	....	....	....	....	....	6	
Kaiwiki	....	3	86	....	....	....	....	....	2	....	....	9	
Waimanalo	....	....	....	14	77	....	....	....	....	....	5	4	
Kilauea	....	1	....	6	10	8	2	47	....	1	16	9	
Waianae	100	....	....	....	....	....	....	....	....	....	....	....	
Union Mill	....	....	11	17	....	....	....	....	9	63	....	....	
Kaeleku	....	83	3	10	3	....	....	....	1	....	....	....	
Niulii	....	....	21	9	4	....	2	....	15	44	....	5	
Waimea	94	....	....	....	6	....	....	....	....	....	....	....	
Average 1934	51.4	14.4	13.0	6.6	3.2	1.8	1.2	1.1	1.1	1.1	1.1	4.0	
" 1933	54.2	15.5	13.2	4.6	1.3	2.1	0.3	1.2	1.4	1.8	0.8	4.7	
" 1932	54.5	17.6	13.4	4.1	0.2	2.1	0.3	1.0	0.9	1.5	1.0	4.7	
" 1931	54.2	18.8	13.7	2.6	....	3.0	0.1	0.7	1.0	2.1	0.9	3.9	
" 1930	56.6	19.9	12.3	0.7	....	3.5	0.1	1.2	....	1.6	0.7	4.2	
" 1929	53.1	21.5	13.0	0.3	....	4.3	0.2	0.5	....	2.1	0.7	5.2	
" 1928	54.7	20.7	12.9	....	....	4.9	....	0.3	....	2.2	0.5	4.3	
" 1927	53.1	23.7	11.8	....	....	4.0	....	0.4	....	1.6	0.1	5.4	
" 1926	48.7	25.6	12.1	....	....	4.5	....	0.5	....	2.1	....	6.5	
" 1925	42.7	30.7	11.9	....	....	2.7	....	0.4	....	2.1	....	9.5	

(1) POJ 213 and 2878 ..... 2%
UD 50 ..... 1%

(2) M 213 ..... 15%
H9806 ..... 3%
KK 456 ..... 2%
H 456 ..... 2%

(3) UD 1 ..... 6%
UD 4 ..... 3%

(4) UD 1 ..... 6%

Annual Synopsis of Mill Data

By W. L. McCleery

Sugar production by the 38 factories of the Association for 12 months ending approximately October 1, 1934, was lower than for the three previous crops. The production amounted to 950,438 tons, or a reduction of 76,432 tons from the record figure of 1,026,870 tons reported for a like period last year. The difference, amounting to about 8 per cent, was due to governmental restriction, many factories having stopped grinding at least temporarily before finishing their 1934 crop. Without restriction, the outturn would have been close to last year's figure.

Factories in all tables are listed, unless otherwise noted, in the order of average sugar production, as given in Synopsis schedules for the previous five years.

A large table giving low-grade massecuite heating equipment and related data is included this year. The other large tables are in substantially the same form as last year.

Cane Varieties

This year, 11 cane varieties are given in Table 1. It includes all varieties comprising 1 per cent or more of the total crop and contains two more varieties than were listed last year. The figures in the table are percentages by weight of the cane harvested.

Hawaiian Uba, which was included in this table at 1.0 per cent in 1932, was below this figure in 1933, but is now back again at 1.1 per cent. The variety K 202 appears for the first time at 1.2 per cent, having been in the minor variety classification for the previous five crops.

Minor Varieties:

There were 11 other canes that comprised less than 1 per cent of the total crop, but amounted to 1 per cent or more of the cane harvested at certain factories. These are listed in the following tabulation in the order of tonnage per cent of the total crop:

1.	UD 1	.48	5.	H 8965	.16	9.	UD 4	.04
2.	M 213	.37	6.	KK 456	.10	10.	POJ 2727	.04
3.	H 456	.18	7.	H 9806	.08	11.	McB 7	.03
4.	POJ 213	.18	8.	St. Mex.	.05			

POJ 2727 is a new variety in this classification. The others have all been previously reported as minor varieties.

Quality of Cane

Table 2 gives the quality of cane by islands and for the group as a whole for the last ten crops. The 1934 quality ratio was 8.56, or .07 poorer than last year, and with this exception is better than that of any year since 1929. Quality ratio was

poorer on Hawaii and Maui, but on Oahu it was better than at any time since 1922. On Kauai it was better than any year since 1926.

The average pol was 12.80, or .06 lower than in 1933, and the juice purity was 86.98, or .35 below last year. Cane fiber was 12.62 and, as shown in Table 2, it has not varied greatly the last ten years; in fact this figure has probably varied less than any other figure appearing in the Synopsis. In 24 years the lowest average fiber was 12.49, in 1927, and highest at 12.95, in 1922.

Chemical Control

Boiling-house recoveries per cent on available, together with the amounts of molasses produced on theoretical, are given for each factory in Table 3.

Eighteen factories show 100 per cent recovery or over on available, or two less than last year. No factory has reported an extremely high recovery that would be clearly out of line. Molasses produced on theoretical has averaged, over quite a period, very close to 90 per cent, both by S. J. M. formula and by gravity solids. A difference of more than 5 points either above or below 90 per cent on either basis has been classed as abnormal. Twelve factories are above this limit and five are below.

The losses on a sucrose basis are shown at the end of the first large table. Total losses are included this year, as are also sucrose recoveries, which are given just before the losses.

The average total loss is lower than at any previous time, as are those for final molasses and undetermined. Bagasse loss increased slightly. The filter cake loss is now one-half of that of a few years ago.

Table 4 gives boiling-house gravity solids and sucrose balances. Two factories report data giving a negative undetermined loss of solids and five factories show a negative undetermined sucrose loss.

Table 5 contains sucrose figures not given in the first large table.

Data submitted by the factories this year include:

Complete sucrose data from all factories except Kaeleku and Waimea, representing 99.3 per cent of the year's sugar production. This is a new high figure.

Mixed juice weights from all factories, Kaeleku and Kohala having installed juice scales the past year.

Molasses scale weights from all factories except Hamakua, Kaiwiki, Kaeleku, Niulii and Waiakea.

Clarity of clarified juice from all factories except Hawaiian Agricultural Company.

Glucose and ash per 100 Brix in molasses. These are given in the first large table for the first time as sufficient factories are now determining these figures to warrant publication. Eight factories did not report glucose and 15 did not report ash. The averages are given, but are not necessarily representative because results from several large factories are missing.

TABLE NO. 2

COMPOSITION OF CANE BY ISLANDS

	Hawaii	Maui	Oahu	Kauai	Whole Group
1925					
Pol	12.35	14.42	13.52	13.24	13.22
Per cent Fiber	12.92	12.40	12.60	12.91	12.74
Purity 1st Expressed Juice	88.02	89.36	87.11	87.19	87.92
Quality Ratio	8.84	7.42	8.12	8.15	8.22
1926					
Pol	12.53	14.66	13.40	13.03	13.24
Per cent Fiber	12.90	12.24	12.72	12.46	12.65
Purity 1st Expressed Juice	87.59	89.03	86.61	86.68	87.45
Quality Ratio	8.73	7.36	8.23	8.33	8.24
1927					
Pol	11.34	14.00	12.61	12.07	12.32
Per cent Fiber	12.84	11.98	12.29	12.65	12.49
Purity 1st Expressed Juice	86.27	87.85	85.87	85.17	86.28
Quality Ratio	9.73	7.71	8.78	9.11	8.91
1928					
Pol	11.57	14.13	13.09	12.09	12.55
Per cent Fiber	12.58	12.56	12.13	12.82	12.50
Purity 1st Expressed Juice	86.60	88.76	86.84	85.16	86.84
Quality Ratio	9.54	7.55	8.39	9.11	8.72
1929					
Pol	11 80	14.56	13.49	12.64	12.90
Per cent Fiber	12.53	13.24	12.28	12.61	12.62
Purity 1st Expressed Juice	86.65	89.14	87.17	85.97	87.18
Quality Ratio	9.45	7.35	8.14	8.69	8.50
1930					
Pol	11.30	13.77	13.05	12.67	12.49
Per cent Fiber	12.73	12.92	12.35	12.57	12.63
Purity 1st Expressed Juice	86.59	88.60	86.98	86.34	87.04
Quality Ratio	9.84	7.79	8.42	8.55	8.76
1931					
Pol	11.51	14.30	13.17	12.55	12.63
Per cent Fiber	12.52	13.04	11.98	12.75	12.53
Purity 1st Expressed Juice	86.18	88.26	86.31	85.49	86.47
Quality Ratio	9.66	7.52	8.42	8.73	8.72
1932					
Pol	11.16	14.02	13.23	12.35	12.42
Per cent Fiber	12.44	13.06	12.29	12.63	12.56
Purity 1st Expressed Juice	86.25	88.71	87.15	85.69	86.86
Quality Ratio	10.05	7.63	8.27	8.89	8.84
1933					
Pol	11.99	14.88	13.39	12.01	12.86
Per cent Fiber	12.47	13.08	12.42	12.35	12.54
Purity 1st Expressed Juice	87.60	89.02	87.25	85.35	87.33
Quality Ratio	9.20	7.23	8.17	9.04	8.49
1934					
Pol	11.50	14.73	13.47	12.83	12.80
Per cent Fiber	12.53	13.19	12.38	12.59	12.62
Purity 1st Expressed Juice	87.00	88.02	87.31	85.76	86.98
Quality Ratio	9.65	7.31	8.06	8.48	8.56

TABLE NO. 3

TRUE BOILING-HOUSE RECOVERY

Comparing per cent Sucrose Available and Recovered

Factory	Available	Obtained	% Recovery on Available	Molasses Produced on Theoretical	
				S. J. M. Formula	Gravity Solids*
H. C. & S. Co.	93.22	93.69	100.5	91.0	93.5
Oahu	93.90	94.18	100.3	82 6	86.1
Ewa	93.27	93.18	99.9	93.9	93.6
Waialua	94.21	94.19	100 0	88.6	90.3
Maui Agr.	92.88	93.92	101.1	87.6	90.1
Pioneer	91.98	91.90	99.9	90 1	99.9
Lihue	91.69	91.88	100.2	90.7	93.1
Olaa	92.89	92.58	99.7	94.8	85.1
Haw. Sug.	93.28	93.05	99.8	93.6	95.3
Kekaha	93.40	92.67	99.2	102.6	100.3
Honolulu	91.82	90.20	98.2	114.4	106.3
Haw. Agr.	92.41	90.94	98.4	100.1	95.7
Onomea	92.57	93.31	100.8	83 4	86.4
Hilo	92.76	93.54	100.8	89.1	93.3
Honokaa	88.90	88.60	99.7	88.6	88.1
Makee	90.06	89.78	99.7	86.4	86.4
McBryde	91.04	90.96	99.9	92.0	93.8
Wailuku	91.06	91.80	100.8	87.2	91.0
Kahuku	91.93	93.44	101 6	88.6	95.5
Hakalau	93.61	93.67	100.1	90.8	91.3
Laupahoehoe	94.10	93.61	99.5	91 7	90.7
Waiakea	94.08	94.80	100.8	93.9	99.7
Koloa	91.14	91.54	100.4	93.1	96.4
Hutchinson	93.02	93.77	100.8	86.8	91.3
Hawi Mill	87.63	87.80	100.2	86.0	86.7
Hamakua	90.93	91.10	100.2	79.3	80.0
Pepeekeo	93.00	93.55	100.6	89.1	90.6
Paauhau	90.94	90.34	99.3	92.6	91.1
Kohala Mill	90.27	88.37	97.9	106.4	99.4
Honomu	91.29	92.60	101.4	87.3	93.6
Kaiwiki	91.68	89.20	97.3	118.6	106.3
Waimanalo	87.59	87.82	100.3	90.8	91.6
Kilauea	90.42	89.75	99.3	87.9	87.0
Waianae	94.15	92.78	98 5	93.2	87.1
Union Mill	92.14	89.87	97.5	101.4	92.5
Kaelekuł	89.16	88.61	99.4	....	67.3
Niulii	92.45	90.95	98.4	106.8	101.1
Waimeał	91.78	89.87	97.9	....	84.3

* The theoretical amount of gravity solids in final molasses assumed to be gravity solids in syrup, less solids accounted for in commercial sugar.

ł As sucrose in syrup and sugar have not been reported, gravity purities have been estimated by adding 0.8 and 0.3 to the apparent purities of syrup and sugar.

Milling

The grinding rate per hour decreased for the first time in 14 crops from last year's high figure of 55.38 to 53.65. It was lower at 28 factories and the tonnage fiber ratio was lower at 25 factories.

Extraction, after increasing steadily for a number of years, has decreased slightly from last year's record of 97.57 to 97.53. Milling loss is the same as last year at 2.50. Extraction Ratio at 19.6 is slightly poorer than last year's record low figure of 19.4.

The extraction was lower than in 1933 at 23 factories, although there were nine factories that obtained over 98 per cent extraction, or one more than last year. Cane quality conditions that would tend to depress extraction were an increase of .08 in fiber and a drop of .06 in pol. However, an increase of .79 in dilution per cent cane and 1.73 tons per hour lower grinding rate favored a higher extraction. Bagasse moisture increased .23 and the pol .01. The net result was the slight drop in extraction recorded above. The average mill pressures remained the same at 71.7 tons per foot of top roller.

Table 6 of milling results is given as in the previous form except that factories are now listed in the order of sugar production.

Boiling-House Work

Clarification results were slightly poorer both as to purity increase and juice clarity, but better work at the other boiling-house stations, from the losses standpoint, has produced very satisfactory results.

Clarification:

The average increase in purity from mixed juice to syrup (Table 7) was 1.54, which is moderately below that for the two previous years.

Juice clarity was 3.21 cm. or just below last year's average. Incidentally, this figure has been decreasing slightly each year for five crops. The best clarity was 3.62 cm. in 1929. The working of somewhat more refractory juices is probably a contributing factor toward poorer clarity and possibly also the change in sampling at some factories this year, since we requested that all clarity tests be made on samples of settled juice, excluding any filtered juice.

The following factories increased or improved settling equipment: Waimanalo, Hawi Mill, Kohala Mill, Lihue and Honokaa; all but the first reported improved juice clarity. The latter factory also improved juice clarity as well as sugar quality by sulfitation.

Filtration:

Filter cake pol has decreased from 1.23 to .83 per cent, largely due to installation of Oliver-Campbell filters at five factories and also to the practice of adding fine-screened bagasse to settlings before filtration, at certain other factories. Settlings from about 48 per cent of all the cane ground are now filtered through Oliver-type filters.

GRAVITY SOLIDS AND SUCROSE BALANCES

Factory	GRAVITY SOLIDS PER 100 GRAVITY SOLIDS IN MIXED JUICE				SUCROSE PER 100 SUCROSE IN MIXED JUICE			
	Filter Cake	Commercial Sugar	Final Molasses	Undetermined	Filter Cake	Commercial Sugar	Final Molasses	Undetermined
H. C. & S. Co.	7.0	78.3	13.7	1.0	0.12	93.58	6.17	0.13
Oahu	5.0	80.2	12.5	2.3	0.23	93.96	5.04	0.77
Ewa	6 8	76.2	15.9	1.1	0.12	93.07	6.32	0.49
Waialua	4.2	81.3	12.9	1.6	0.14	94.06	5.13	0.67
Maui Agr.	...	82.9	15.4	1.7	....	93.92	6.24	—0.16
Pioneer	4.9	75.8	19.0	0.3	0.46	91.48	7.23	0.83
Lihue	4.4	75.9	18.1	1.6	0.25	91.65	7.54	0.56
Olaa	4.9	78.4	15.6	1.1	0.10	92.49	6.74	0.67
Haw. Sug.	3.2	79.9	15.7	1.2	0.33	92.74	6.29	0.64
Kekaha	3.7	79.6	16.5	0.2	0.14	92.54	6.77	0.55
Honolulu	4.6	75.3	21.5	—1.4	0.26	89.97	9.36	0.41
Haw. Agr.	2.8	77.8	18.2	1.2	0.28	90.69	7.60	1.43
Onomea	4.3	79.0	14.5	2.2	0.19	93.13	6.20	0.48
Hilo	4.3	78.5	16.0	1.2	0.38	93.18	6.45	—0.01
Honokaa	5.7	70.4	21.0	2.9	0.41	88.24	9.83	1.52
Makee	6.8	70.8	19.2	3.2	0.40	89.42	8.59	1.59
McBryde	3.5	74.7	20.0	1.8	0.15	90.82	8.24	0.79
Wailuku	4.8	74.6	18.5	2.1	0.37	91.46	7.80	0.37
Kahuku	4.4	75.9	18.6	1.1	0.21	93.24	7.15	—0.60
Hakalau	4.5	79.2	14.9	1.4	0.22	93.46	5.80	0.52
Laupahoehoe	3.6	80.7	14.0	1.7	0.12	93.50	5 41	0.97
Waiakea	4.8	81.0	13.9	0 3	0.14	94.67	5.56	—0.37
Koloa	4.8	73.9	20.2	1.1	0.15	91.40	8.25	0.20
Hutchinson	4.9	77.9	15.5	1.7	0.19	93.59	6.06	0.16
Hawi Mill	5.3	69.5	21.9	3.3	0.44	87.41	10.64	1.51
Hamakua	...	78.6	17.1	4.3	....	91.10	7.18	1.72
Pepeekeo	5.7	77.5	15.5	1.3	0.39	93.19	6.24	0.18
Paauhau	6.0	74.0	18.2	1.8	0.62	89.78	8.39	1.21
Kohala Mill	4.8	72.3	22.8	0.1	0.36	88.05	10.35	1.24
Honomu	6.4	75.2	17.0	1.4	0.17	92.44	7.60	—0.21
Kaiwiki	2 5	77.9	20.7	—1.1	0.26	88.97	9.87	0.90
Waimanalo	4.8	67.7	25.2	2.3	0.45	87.42	11.27	0.86
Kilauea	5 2	72.6	19.2	3.0	0.88	88.96	8.42	1.74
Waianae	4.7	79.8	13.4	2.1	0.37	92.44	5.45	1.74
Union Mill	5.7	74.0	18.8	1.5	0.79	89.16	7.97	2.08
Kaeleku	5.6	71.2	15.6	7.6	1.06	84.47	7.59	6.88†
Niulii	5.9	75.1	19.0	0.0	0.35	90.63	8.06	0.96
Waimea	4.3	74.8	17.6	3.3	0.57	89.36	7.73	2.34†

TABLE NO. 5. SUCROSE DATA*

Factory	Cane Sucrose %	MIXED JUICE		SYRUP		Sugar Sucrose %
		Sucrose %	Gravity Purity	Gravity Purity	Increase in Purity	
H. C. & S. Co.	15.57	12.00	88.58†	88.58	0.00	97.93
Oahu	13.99	11.99	87.63	88.46	0.83	98.13
Ewa	13.41	11.62	83.78	86.52	2.74	97.98
Waialua	14.53	12.77	87.55	88.90	1.35	98.14
Maui Agr.	15.40	12.83	86.84†	87.22	0.38	97.79
Pioneer	14.13	12.24	84.36	85.52	1.16	98.05
Lihue	12.15	11.27	83.60	85.00	1.40	97.84
Olaa	11.58	10.63	85.62	87.50	1.88	97.63
Haw. Sug.	14.82	12.93	85.74	87.01	1.27	97.68
Kekaha	13.95	12.14	86.90	87.90	1.00	98.10
Honolulu	13.70	11.40	85.60	87.50	1.90	100.00
Haw. Agr.	11.29	10.09	85.80	86.42	0.62	97.74
Onomea	11.88	9.70	85.02	86.69	1.67	97.27
Hilo	11.73	10.56	85.27	86.23	0.96	97.71
Honokaa	10.33	9.04	81.66	83.00	1.34	97.86
Makee	11.79	10.38	82.20	83.36	1.16	97.97
McBryde	13.10	11.10	83.08	83.82	0.74	97.84
Wailuku	13.53	10.70	83.20	84.21	1.01	98.01
Kahuku	11.78	10.36	82.55	83.59	1.04	97.77
Hakalau	11.26	9.54	85.78	86.91	1.13	97.34
Laupahoehoe	12.10	10.43	87.47	88.21	0.74	98.13
Waiakea	13.28	11.08	86.63	88.45	1.82	97.83
Koloa	11.79	9.59	81.93	83.32	1.39	97.79
Hutchinson	12.00	9.88	84.32	85.49	1.17	97.28
Hawi Mill	12.27	11.92	80.43	82.38	1.95	98.02
Hamakua	11.82	11.01	85.09†	85.00	—0.09	98.08
Pepeekeo	11.06	10.22	84.41	86.65	2.24	98.09
Paauhau	11.09	9.76	83.71	85.17	1.46	96.87
Kohala Mill	12.51	11.63	83.43	84.71	1.28	98.04
Honomu	10.52	8.71	83.51	85.35	1.84	97.96
Kaiwiki	12.84	11.72	88.26	88.33	0.07	97.77
Waimanalo	11.77	10.59	78.15	79.33	1.18	97.18
Kilauea	11.99	11.09	82.05	83.52	1.47	97.16
Waianae	14.78	12.40	87.63	88.79	1.16	97.80
Union Mill	12.22	11.24	85.02	85.70	0.68	97.34
Niulii	11.36	10.35	85.13	86.20	1.07	97.61
‡ True Average 1934	12.94	11.20	85.25	86.47	1.22	97.88
" " 1933	13.05	11.34	85.63	86.85	1.22	97.96
" " 1932	12.60	11.00	85.15	86.46	1.31	98.22
" " 1931	12.75	11.17	84.74	85.78	1.04	98.05
" " 1930	12.67	11.08	85.35	86.49	1.14	98.05
" " 1929	13.08	11.44	85.58	86.60	1.02	98.00
" " 1928	12.69	11.22	85.15	86.23	1.08	97.86
" " 1927	12.46	11.01	84.53	85.86	1.33	97.79
" " 1926	13.35	11.68	85.38	86.66	1.28	97.67

* Sucrose in bagasse and filter cake is assumed to be the same as pol.
† Clarified juice. ‡ Refinery data from Honolulu included in 1933 and 1934 averages.

TABLE NO. 6. MILLING RESULTS

Factory	Extraction	Milling Loss	Extraction Ratio	Imbibition % Cane	Tonnage Ratio	Tonnage Fiber Ratio
H. C. & S. Co.	98.01	2.31	15.0	49.64	1.55	20.5
Oahu	98.50	1.73	12.6	35.21	1.68	20.0
Ewa	98.29	1.78	13.4	35.81	1.62	20.6
Waialua	98.08	2.04	14.2	35.81	2.16	29.1
Maui Agr.	97.80	2.56	16.7	40.02	1.90	25.0
Pioneer	97.71	2.36	16.9	37.51	2.33	31.5
Lihue	97.29	2.54	21.3	28.40	2.37	30.2
Olaa	96.73	2.97	25.8	29.33	2.45	31.0
Haw. Sug.	98.12	2.14	14.6	33.84	1.75	22.5
Kekaha	97.60	2.65	19.3	33.68	2.44	30.3
Honolulu	97.85	2.46	18.1	37.76	1.44	17.2
Haw. Agr.	96.97	2.98	26.8	30.09	1.98	22.4
Onomea	98.23	1.75	14.8	41.25	2.13	25.5
Hilo	97.78	1.92	16.4	31.94	1.93	26.0
Honokaa	93.99	4.78	46.7	33.94	1.83	23.6
Makee	97.13	2.94	25.2	29.87	2.16	24.6
McBryde	97.18	2.74	21.1	37.84	1.44	19.2
Wailuku	98.51	1.67	12.5	44.28	1.25	14.9
Kahuku	97.78	2.26	19.4	29.76	1.64	18.8
Hakalau	98.07	1.80	16.2	36.16	1.76	20.9
Laupahoehoe	97.31	2.76	23.1	33.21	2.30	26.9
Waiakea	97.26	2.78	21.2	40.38	1.91	24.8
Koloa	97.43	2.52	21.6	40.62	1.43	17.1
Hutchinson	97.64	2.64	22.2	37.80	1.88	20.0
Hawi Mill	96.79	2.98	24.5	23.28	2.11	27.7
Hamakua	96 51	2.95	25.1	29.62	1.53	21.3
Pepeekeo	97.63	2.02	18.3	27.65	2.00	25.8
Paauhau	96.89	2.31	21.0	35.93	1.06	15.6
Kohala Mill	96.53	3.33	26.9	26.48	1.71	22.1
Honomu	97.53	2.06	19.9	39.60	1.64	20.4
Kaiwiki	96.35	3.70	29.1	27.33	1.78	22.4
Waimanalo	98.47	1.46	12.6	29.42	1.99	24.2
Kilauea	95.79	3.72	31.2	27.67	1.64	22.1
Waianae	97.89	2.66	18.2	35.55	1.71	19.8
Union Mill	94.93	4.50	37.0	28.29	1.77	24.3
Kaeleku	95.55	4.03	33.2	36.61	1.39	18.6
Niulii	93.88	5.24	46.4	28.17	1.78	23.5
Waimea	97.63	2.66	19.1	34.77	1.64	20.4

TABLE NO. 7

True Averages of Factories Basing Control on Mixed Juice

	1929	1930	1931	1932	1933	1934
First Expressed Juice—						
Brix	17.76	17.36	17.57	16.74	17.67	17.71
Purity	86.69	86.68	86.10	86.47	86.93	86.70
"Java ratio"	82.1	81.5	81.8	82.0	81.6	81.6
Mixed Juice—						
Brix	13.29	12.98	13.13	12.75	13.09	13.05
Purity	83.89	83.73	83.21	83.56	84.11	83.86
Weight % cane	110.18	109.77	110.28	108.62	111.00	111.56
Extraction	97.28	97.25	97.36	97.49	97.50	97.49
Extraction ratio	21.7	21.8	21.2	20.6	20.1	20.0
Last Expressed Juice—						
Pol	1.99	1.94	2.01	1.84	1.94	1.96
Purity	68.73	68.54	68.19	67.71	68.83	68.59
Imbibition Water % Cane	32.44	32.15	32.23	32.59	33.11	33.82
Syrup—						
Brix	63.38	64.09	64.16	64.38	64.66	65.43
Purity	85.24	85.17	84.57	85.22	85.73	85.40
Increase in purity	1.35	1.44	1.36	1.66	1.62	1.54
Lbs. Avail. CaO per Ton Cane	1.38	1.30	1.37	1.23	1.25	1.22
Filter Cake—						
Pol	2.27	1.82	1.65	1.20	1.14	0.89
Weight % cane	2.87	2.96	2.99	3.23	3.44	3.73
Pol % pol of cane	0.52	0.44	0.40	0.33	0.31	0.26

Filter cake pol was lower at 26 factories. While the amount of cake per cent cane increased from 3.24 to 3.68 per cent, the sugar actually lost as per cent sucrose in cane was reduced from .31 to .24.

Evaporation:

Syrup density has increased from 64.98 to 65.59 Brix, a new high figure. Additions to evaporator equipment were made at two factories.

Commercial Sugar:

Sugar pol is again slightly lower. This year's average pol was 97.46, compared with 97.54 in 1933. The peak for 13 years previous to 1933 was 97.76, in 1932. The Crockett group of factories averaged 97.53 pol against 97.60 last year. The "other" factories averaged 96.93, or .05 lower than last year.

Final Molasses:

Final molasses gravity purity is lower for the eighth successive season. The purity for Kahuku factory is now lower than their old record for any Hawaiian factory, which was obtained in 1927.

The present average purity of 34.64 is 1.07 lower than last year, or a reduction several times larger than any obtained in recent years. The reduction was obtained largely through the recently adopted practice of warming low-grade massecuite just before purging, in place of dilution. Several factories installed

TABLE NO. 8

LOW-GRADE MASSECUITE WORK

Factories Listed in Order of Molasses Purity

	Molasses		Remelt		Molasses		Remelt
	Gr. Pur. 1934	Change From '33	Ap. Pur. 1934		Gr. Pur. 1934	Change From '33	Ap. Pur. 1934
Kahuku	30.78	—1.22	73.3	Waianae	34.61	+ .47	67.5
Hutchinson	31.87	— .95	72.6	Kekaha	34.78	—3.25	71.5
Ewa	32.08	—1.31	68.6	Makee	34.82	— .82	65.7
Koloa	32.39	— .46	73.0	Kilauea	35.03	—2.11	66.5
Hakalau	32.49	—3.20	73.5	Hawn. Agr.	35.07	—2.35	73.2
Laupahoehoe	32.92	— .48	66.2	Maui Agr.	35.20	— .81	71.1
Pepeekeo	33.14	—1.39	74.6	Hamakua	35.63	+ .17	70.4
McBryde	33.43	+ .68	73.1	Onomea	35.63	—1.55	73.6
Hilo	33.47	—2.66	69.8	Honomu	35.66	— .95	77.6
Hawn. Sug.	33.77	— .17	75.0	Olaa	35.90	—1.54	73.0
Waiakea	33.77	—2.36	68.4	Waimea	36.03	+1.26	76.9
Waimanalo	33.87	— .82	74.1	Honolulu	36.40	— .46	75.4
Wailuku	33.90	—3.32	66.8	Honokaa	36.77	—2.27	68.7
Pioneer	33.95	— .31	67.0	Kohala Mill	36.79	—1.17	67.4
Waialua	33.98	—1.45	68.7	H. C. & S. Co.	37.11	+ .18	72.1
Lihue	34.0	+ .20	67.6	Paauhau	37.18	—5.58	68.8
Oahu	34.06	+ .99	71.9	Hawi Mill	38.04	— .25	65.8
Niulii	34.46	—7.62	73.5	Kacleku*	38.59	—1.10	78.3
Union Mill	34.57	—2.42	68.2	Kaiwiki*	41.23	+ .08	86.7

*String-proof—No crystallizers.

AVERAGES

Year	Molasses Purity	Mol. Pur. Change	Remelt Purity
1934	34.64	—1.07	70.9
1933	35.71	— .19	73.0
1932	35.90	— .42	74.7
1931	36.32	— .37	75.7
1930	36.69	— .33	75.7
1929	37.02	— .37	76.6
1928	37.39	— .20	75.9
1927	37.59	— .38	75.7
1926	37.97	+ .65	75.4

massecuite warming facilities the latter part of the season and others are about to improve their present equipment, so that further reduction in purity is expected. By using a net value of 2.5 cents per pound on the sugar saved through the increased recovery due to lower purity, the additional return is over $200,000 this year.

Table 8 lists the factories in the order of molasses gravity purity for convenient reference and without prejudice to factory operators.

Remelt Sugar:

The remelt sugar purity averaged 70.9 with 16 factories below 70 purity. An increase to 70 purity or slightly over for these factories should not result in any marked increase in their average molasses purity because of the smaller quantity of low-grade material to be handled. Higher remelt purity will also improve commercial sugar quality.

Table 8 gives remelt sugar purities for all factories with previous yearly averages.

Recovery

Both boiling-house and over-all recoveries are better than previously. On a sucrose basis, the boiling-house recovery of 92.17 was higher than last year by .17. The over-all recovery of 89.92 was higher by .14. The new high pol recoveries are 92.87 and 90.58 per cent respectively.

Analysis of the various factors affecting recovery indicates that poorer juice purity alone would have reduced the over-all recovery about .25, but the lower losses in molasses, filter cake, and undetermined should have increased the net recovery to approximately that actually obtained.

Recovery Per Cent Calculated Recovery and Recovery Ratio

Table 9 is given in the same form as previously except that factories are listed in the order of sugar production.

Calculations are the work of C. E. Ashton, assisted by Raymond Elliott and others of the Sugar Technology Department.

TABLE NO. 9

COMPARISON OF ACTUAL AND THEORETICAL RECOVERIES

Factory	Mill (Extraction)	Recovery % Calculated Recovery*		Recovery Ratio†
		Boiling House	Over All	Over All
H. C. & S. Co.	98.01	98.69	96.91	99.93
Oahu	98.50	100.37	99.04	101.78
Ewa	98.29	100.02	98.45	101.73
Waialua	98.08	99.71	97.96	101.19
Maui Agr.	97.80	99.62	97.73	99.77
Pioneer	97.71	98.52	96.53	98.80
Lihue	97.29	99.63	97.22	100.72
Olaa	96.73	98.29	95.39	98.52
Haw. Sug.	98.12	99.70	98.00	100.97
Kekaha	97.60	98.55	96.39	99.91
Honolulu	97.85	96.75	94.83	98.34
Haw. Agr.	96.97	98.11	95.35	98.71
Onomea	98.23	98.96	97.46	100.39
Hilo	97.78	99.30	97.27	100.48
Honokaa	93.99	96.55	91.04	93.76
Makee	97.13	97.90	95.36	97.92
McBryde	97.18	99.52	97.01	100.22
Wailuku	98.51	99.10	97.80	100.88
Kahuku	97.78	102.32	100.26	103.73
Hakalau	98.07	99.32	97.59	100.43
Laupahoehoe	97.31	98.79	96.29	98.98
Waiakea	97.26	100.19	97.64	100.17
Koloa	97.43	100.20	97.89	100.67
Hutchinson	97.64	100.72	98.59	101.57
Hawi Mill	96.79	95.49	92.73	96.02
Hamakua	96.51	98.10	95.08	96.14
Pepeekeo	97.63	99.29	97.08	99.97
Paauhau	96.89	96.34	93.61	95.62
Kohala Mill	96.53	94.97	91.88	94.72
Honomu	97.53	99.67	97.47	99.82
Kaiwiki	96.35	93.90	90.64	93.05
Waimanalo	98.47	98.20	96.89	100.71
Kilauea	95.79	96.78	92.92	96.17
Waianae	97.89	97.89	95.96	98.92
Union Mill	94.93	94.93	90.40	92.81
Kaeleku	95.55	94.63	90.61	93.80
Niulii	93.88	96.66	91.01	93.41
Waimea	97.63	95.32	93.25	96.01

*Calculations are same as last year. The gravity purity of molasses is 30.0.

†The basis of this calculation is the reciprocal of cane ratio after correction to sugar ratio, with 98 extraction, syrup purity 1 less than the apparent purity of first expressed juice, sugar purity 98 (97.5 pol), gravity purity of molasses 33.3 and no other losses.

ANNUAL SYNOPSIS OF MILL DATA—SHOWING RESULTS FROM 38 HAWAIIAN FACTORIES FOR CROP OF 1934

| Factory | MILLING RESULTS: Extraction | Milling Loss | Extraction Ratio | CANE: Pol | % Fiber | Tons per Ton Commercial Sugar | Tons Ground per Hour | Tonnage Ratio | Tonnage Fiber Ratio | BAGASSE: Pol | % Moisture | % Fiber | Weight per 100 Cane | FIRST EXPRESSED JUICE: Brix | Purity | Pol of Cane x 100 = Purity | MIXED JUICE: Brix | Purity | pH Hot Limed Juice | Net Weight per 100 Cane | LAST EXPRESSED JUICE: Pol | Purity | IMBIBITION WATER: Weight per 100 Cane | Dilution % Absolute Juice | JUICE TO EVAPORATORS: Purity | pH | CLARIF. JUICE: Clarity (cm.) | SYRUP: Brix | Purity | Increase in Purity | pH | FILTER CAKE: Pol | Weight per 100 Cane | LIME USED: Lbs. Available CaO per Ton of Cane | COMMERCIAL SUGAR: Pol | % Moisture | Deterioration Factor | Weight per 100 Cane | Pol per 100 Cane | Pol per 100 Pol of Cane | Pol per 100 Pol of Juice | Production in Thousands of Tons | Remelt Sugar: Apparent Purity | FINAL MOLASSES: Weight per 100 Commercial Sugar | Gravity Solids | Gravity Purity | Glucose per 100 Brix | Ash per 100 Brix | RECOVERIES Per 100 Sucrose in Cane: Boiling House | Total | LOSSES PER 100 SUCROSE IN CANE: Total Losses | Bagasse | Filter Cake | Final Molasses | Undetermined | Factory |
|---|---|---

CANE MILL DATA, CROP OF 1934

Factory	MILLING PLANT (Sizes in inches)	REVOLVING KNIVES — First Set: Number	First Set: Distance Apart Inches	First Set: Distance from Conveyor Inches	First Set: Revolutions per Minute	Second Set: Number	Second Set: Distance Apart Inches	Second Set: Distance from Conveyor Inches	Second Set: Revolutions per Minute	MILL OPENINGS*: Crusher	1st Mill: Front	1st Mill: Back	2nd Mill: Front	2nd Mill: Back	3rd Mill: Front	3rd Mill: Back	4th Mill: Front	4th Mill: Back	5th Mill: Front	5th Mill: Back	SPEED OF ROLLERS—FEET PER MINUTE: Crusher	1st Mill	2nd Mill	3rd Mill	4th Mill	5th Mill	6th Mill	PRESSURE ON ROLLERS—TONS PER LINEAR FOOT: Crusher	1st Mill	2nd Mill	3rd Mill	4th Mill	5th Mill	6th Mill	Tons Cane per Hour	Tonnage Fibre Ratio	Factory
H. C. & S. Co.	K(2),2RC32x78,S72,12RM34x78	28	9 3/4	23	1200	48	5	16	1200	7/32	7/8	0	3/16	0	3/16	0	3/16	0	...	...	35.5	24.5	27.4	31.7	25.1	...	...	37.1	67.4	61.8	72	78	...	...			H. C. & S. Co.
"	K(2),2RC32x78,S72,12RM34x78	28	9 3/4	23	1200	48	5	16	1200	7/32	7/8	0	3/16	0	3/16	0	3/16	0	..	..	33.9	25	26.9	30.9	25.7			27.1	67.4	61.8	72	78					"
Oahu	K,2RC36x78,S72,12RM34x78	28	5 1/2	18	490	..	....	.....	....	1/4	1/2	0	5 8	0	1/2	0	1/2	0	...	..	37.2	25.6	17.6	19.8	21.2			30.5	66.5	64.7	81	69					
"	K,2RC36x78,S72,12RM34x78	28	5 1/2	18	490	..	....	.....	....	1/4	5/8	0	5/8	0	1/2	0	1/2	0	...	..	37.2	25.6	17.6	20.2	20.7			31.1	62.6	64.7	81	69					"
Ewa	K(2),2RC34x78,18RM34x78	72	1	15	580	72	1	1/2	580	7/8	7 8	1/4	3/4	0	3/4	0	3/4	0	5 8	0‡	29 2	19.6	21.1	23.8	29.3	29.3	28	61.5	73.1	70.1	81	68	73.5	68			
Waialua	K(2),2RC34x78,15RM34x78	76	1 1/2	16	580	76	1 1/2	2	580	7/8	3/8	0	3/8	0	3/8	0	3/8	0	3/8	0	46.2	32.4	28.1	29	31.3	26.4		46.2	70.8	70.8	72	72	78.8		49.10	20.1	
Maui Agr.	K(2),3RC34x66,12RM34x66	72	7/8	10	900	72	7/8	7/8	900	7/8x1/4	3/8	0	1/2	0	3/16	0	1/16	0	..	..								60	62	64	72	80					Maui Agr.
" "	K(2),3RC34x66,12RM34x66	72	7/8	10	900	72	7/8	7/8	900	7/8x1/4	3/8	0	1/2	0	3 16	0	1/16	0	...	..								60	62	65	72	80					"
Pioneer	K,2RC32x72,S72,15RM34x72	27	2 1/2	11	690	..	....	.....	....	3/4	7/16	3/32	7/16	1/32	7/16	1/32	7/16	1/32	7/16	1 32	41 9	31 6	32.9	28 5	29 5	31.9	..	52.6	83.9	75	84.4	84	84.4	..			
Lihue	K,2RC34x78,S72,12RM34x78	18	3 1/8	4 1/2	600	..	....	.....	....	1/8	3/4	0	9/16	0	5/16	0	1/4	0	...	..	51 3	29.1	29.1	32.1	32.1			46.9	66.6	67.5	78	78					
Olaa	K,2RC34x78,S72,12RM34x78	26	2 1/2	12	600	..	....	.....	....	1/4	3/4	3/16	3/4	1/8	3/8	0	3/8	0	...	...	50	32.4	25.3	29.6	34.1	...	...	42.6	77.5	69	78	78					
Haw. Sug.	K,2RC28x72,S72,12RM34x78	36	3	12	560	..	....	.....	....	1 16	3 8	0	3/8	0	5/16	0	5/16	0	..	..	30.5	18.8	21.7	25.2	26.2			41.7	73.8	73.8	78	78					Haw. Sug.
Kekaha	K(2),2RC24x54,15RM32x60	56	15/16	14	860	20	2 3/4	2 1/2	860	1 1/2	7/8	1/4	5/8	1/8	5, 8	1, 16	9/16	1/32	1/2	0	32 1	21 8	22 1	25	27 8	27 8	..	..	75	75	78	78	72				
Honolulu	K(2),2RC34x78,12RM34x78	36	2	14	570	26	2 3/4	3	575	-1 1/2	0	-3/4	3/4	-3 16	1/2	0	5, 8	1/4	...	..	27.5	21 4	18.6	19 2	19.6	..	..	37 2	72	70.8	78	78					
Haw. Agr.	K(2),3RC32x60,12RM32x66	22	2 1/2	24	495	22	2 1/2	2	509	5/8x1/2	1 2	1/4	11/16	1/16	1/2	1/16	3 8	0	..	..	23.8	22.2	22.5	25.1	27.3	...	...	71.5	70.2	73.3	73.3	73.6	...	...	49.94	22.4	Haw. Agr
Onomea	K,2RC28x60,S54,12RM32x66	22	2 1/2	14	480	..	....	.....	....	1/4	3/4	1/8	1/2	0	7/16	0	7/16	0	..	..	35 2	32 2	22 6	25 6	22 8			22.4	76.4	64	78	78					
Hilo	K(2),2RC32x66,12RM32x66	10	5	16	200	24	2 3/8	1	400	3/16	3/4	1 16	1/4	0	5/16	0	3 8	0	..	..	40 2	24 5	22 3	26 4	17 7			22 5	68 7	68 7	68 7	68 7					
Honokaa	K(2),3RC34x66,12RM32x66	16	3 1/2	12	550	16	3 1/2	1	550	1x1/4	3/4	1 8	1/2	1/16	3/8	0	3/16	0	..	..	24	21 9	20 7	28 4	25 8			76 4	77 7	77 1	64 1	64 1					
Makee	K,2RC34x72,S72,9RM34x72	22	3	6	550	..	....	.....	....	0	3/8	0	5/16	0	1/4	0	...	...	...	...	49.2	20 5	23 6	27 1				46.7	78	78	78	78					M
McBryde	K,2RC34x72,S72,9RM34x84	76	1 3/4	6 1/2	690	..	....	.....	....	3/8	1 2	0	7/16	0	15,32	0	...	...	...	...	33.5	19.5	19.5	20.5	...	...	...	50	67.9	70.7	73.1	...	...	...	47.07	19.2	McBryde
Wailuku	K,2RC30x72,12RM34x78	26	2 9/16	2 1/2	575	..	....	.....	....	3/8	3/8	0	5/16	0	5/16	0	1/4	0	..	..	33.5	19 4	16.9	19.5	21 6			35.7	68.4	61.1	80.3						Wailuku
Kahuku	K,2RC30x60,S54,9RM34x72	10	5 1/2	24 1/2	420	..	....	.....	....	7/16	1/4	0	1/8	0	1/8	0	...	...	..	..	29.9	17 7	20 2	22 2				26.1	80.4	68.7	80.4						Kahuku
Hakalau	2RC24x54,12RM9 32x60,3-32x66	..	....	....	....	..	....	.....	....	1/4	3/4	0	1/4	0	1 8	0	1 4	0	..	..	30 5	21 6	21 3	26 7	16 1				64.1	64.1	80.4					Hakalau
Laupahoehoe	K,3RC34x60,9RM32x60	16	3 1/2	1 1/4	400	..	....	.....	....	1/2x0	7/16	0	5/16	0	3/16	0	...	...	...	...	22.5	19.5	19.8	22	...	...	...	70.4	78.2	76.8	78.2	...	...	...	56.40	20.5	Laupahoehoe
Waiakea	K,3RC34x60,9RM32x60	22	2 1/2	1/2	430	..	....	.....	....	1/2x0	7/16	0	3/16	0	1/8	0	...	...	...	..	17.2	18.6	21	23	...	...	...	75.4	70.2	67	74	...	...	...	31.90	24.8	Waiakea
Koloa	K,2RC28x60,12RM32x66	12	4	10	300	..	....	.....	....	1/8	5/8	1/8	3/8	1/16	1/4	0	3/16	0	...	...	24.8	17.3	17.3	17.3	17 3			80	75	72.7	80.7	80.7				17.1	
Hutchinson	K(2),3RC31x60,9RM32x60	32	2 1/2	20	580	22	2 1/2	1 1/2	495	5/8x1/16	1/2	0	1/4	0	1/8	0	...	...	...	...	16 5	18 2	20 2	21 8				80	75	76.4	80					17.1	Hutchinson
Hawi Mill	K(2),2RC28x54,12RM30x54	32	2 1/4	12	600	18	3	0	600	3/8	5/16	1/8	1/4	1/16	3/16	0	1/8	0	...	...	35 4	27 3	21	23	23			33.1	66 6	72 8	80	80				17.7	Hawi Mill
Hamakua	K,2RC30x60,12RM32x60	32	4	3	400	..	....	.....	....	3/8	9/16	1 32	9/16	1/32	5, 16	0	3/16	0	...	...	25.5	16.2	17.4	19 8	21.9	...	...	...	72	77.4	72	72	...	...	...	21.3		Hamakua
Pepeekeo	2RC24x54,9RM32x60	..	....	....	....	..	....	.....	....	1/8	3/4	0	3/16	0	1/8	0	...	...	...	...	31.4	21.7	23.7	26.1	...	...	...	...	77	77	77	...	...	...	33.32	25.8	Pepeekeo
Paauhau	2RC26x60,12RM32x66	..	....	....	....	..	....	.....	....	7/16	7/16	0	1/4	0	3/16	0	5/32	0	...	...	24.2	14.9	17.3	19.2	21.2	...	...	...	73.6	71.3	63.7	69.6						Paauhau
Kohala Mill	K(2),3RC34x60,9RM32x60	12	4	18	550	36	1 1/2	1 1/2	550	1/2x1/16	3/8	0	1/4	0	1/8	0	..	..	...	.	18.5	20 5	22 5	19 5				80	76	79	72					17.1	Kohala Mill
Honomu	3RC34x60,9RM32x60	..	....	....	....	..	....	.....	....	3/4x0	5 8	0	3/16	0	5/16	0	..	..	...	.	21 5	17 6	20 2	22 4				89	68 1	72 1	80					20.4	Honomu
Kaiwiki	K,2RC24x60,9RM32x60	18	3 1/2	4	400	..	....	.....	....	0	7/16	0	1/4	0	3/16	0	...	...	...	...	22.3	17.8	19.9	22	...	...	...	...	72	71.2	74	...	...	...	29.65	22.4	Kaiwiki
Waimanalo	K,3RC32x54,9RM30x54	28	1 7/8	3 1/2	500	..	....	.....	....	1/2x0	3/8	0	1/4	0	3/16	0	...	...	...	...	20.8	19.7	18.3	19.1	...	...	...	79.6	79.6	79.6	79.6	...	...	...	26.85	24.2	Waimanalo
Kilauea	K,3RC32x60,9RM32x60	22	2 1/2	1 1/2	500	..	....	.....	....	1/2x1/8	1/2	0	5/16	0	3/16	0	..	..	....	..	19.5	18.3	24.8	19 2				70	72	72							Kilauea
Waianae	K(2),3RC30x60,9RM30x60,3-32x60	44	2 1/2	10	500	44	2 1/2	2	500	3/4x1/8	1/2	1 8	1/2	1/16	1/2	0	...	..	....	..	16.9	16 9	16 5	17 6				70	70	70					25.6	1 8	Waianae
Union Mill	K,3RC32x60,6RM30x60	36	2 7/8	2 1/2	450	..	....	.....	....	5 16	0	3/16	0	....	..	..	....	..	....	..	16.1	18 5	19.7					68 9	68 1	68 9					21 1		Union Mill
Kaeleku	K,2RC24x54,9RM32x60	8	6	8	250	..	....	.....	....	1/2	5/8	0	1/4	0	1/8	0	..	..	....	..	19.8	16 6	18	20 4					67.6	67.6	67.6				23.1	18.6	Kaeleku
Niulii	K,9RM30x54	20	5	3 1/2	500	..	....	.....	....	...	5/8	1 16	3/16	1/32	3/16	0	....	..	....	..	...	19.2	23	21 6						72.8	70.8				14.1	23.1	Niulii
Waimea	2RC24x42,12RM26x42	..	....	....	....	..	....	.....	....	0	1/2	0	3/8	0	1/4	0	1/8	0	...	...	18.9	13.6	13.6	14	17	...	...	...	57.1	57.1	48	48	...	...	16.76	20.4	Waimea

* Measurements in Inches.
† Tons Cane per one Tandem.
‡ Ewa—6th Mill openings ½x0.

CANE MILL DATA, CROP OF 1934 (CONTINUED)

Factory	SURFACE GROOVES PER INCH FRONT, TOP, BACK						JUICE GROOVES*																								RETURNER BAR*																		Factory
							1st Mill						2nd Mill						3rd Mill						4th Mill						5th Mill						DISTANCE FROM TOP ROLLER-CENTER						WIDTH						DISTANCE FROM BACK ROLLER						
	Crusher	1st Mill	2nd Mill	3rd Mill	4th Mill	5th Mill	Front			Back			Front			Back			Front			Back			Front			Back			Front			Back			Crusher	1st Mill	2nd Mill	3rd Mill	4th Mill	5th Mill	Crusher	1st Mill	2nd Mill	3rd Mill	4th Mill	5th Mill	Crusher	1st Mill	2nd Mill	3rd Mill	4th Mill	5th Mill	
							Width	Depth	Pitch	Width	Depth	Pitch	Width	Depth	Pitch	Width	Depth	Pitch	Width	Depth	Pitch	Width	Depth	Pitch	Width	Depth	Pitch	Width	Depth	Pitch	Width	Depth	Pitch	Width	Depth	Pitch																
H. C. & S. Co.	4 9_4/9	11/3, 11/3, 11/3	11/3, 4, 8	11/3, 4, 8	11/0, 4, 8		7/32	2	21/4	....	....	....	7/32	2	21/4	7/32	13/4	2	7/32	2	21/4	7/32	1 3/4	2	7/32	2	21/4	7/32	13/4	2	....	....	....	....	....	....		12 1 4	12 5/16	12 3/8	13														H. C. & S. Co.
"	4 9_4/9	11/3, 11/3, 11/3	11/3, 4, 8	11/3, 4, 8	11/0, 4, 8		7/32	2	21/4	....	....	....	7/32	2	21/4	7/32	13/4	2	7/32	2	21/4	7/32	13/4	2	....	....	....	....	....	....	....	....	....	....	....	....		12 5/16	12 3/8	12 1/2	13 1/8														"
Oahu	Krajewski	11/3, 22/3, 22/3	11/3, 22 3, 22/3	11/3, 22/3, 22/3	11/0, 0, 0		3/8	21/4	21/4	5/16	11/4	25/8	5/16	13/4	25/8	5/16	11/2	25/8	5/16	15/8	25/8	5/16	11/2	25/8	5/16	15/8	25/8	5/16	11/2	25/8	5/16	15/8	25/8	....	....	....		12 5/8	14 1/4	13 1/2	14 3/8														Oahu
"	Krajewski	11/3, 22/3, 22/3	11/3, 22/3, 22/3	11/3, 22/3, 22/3	11/0, 0, 0		3/8	2	21/4	1/4	15/8	25/8	5/16	13/4	25/8	5/16	15/8	25/8	5/16	11/2	25/8	5/16	13/4	25/8	....	....	....	....	....	....	....	....	....	....	....	....		11/2	16 1/16	11 1/16	16 1/16	15 7/8													"
Ewa†	2/3, 2/3	11/3, 11/3, 11/3	11/3, 22/3, 3 1/3	11/3, 22/3, 3 1/3	11/0, 22/3, 22/3	11/3, 2 2/3, 2 2/3	9/32	11/2	3	5/32	11/2	3	9/32	11/2	3	5/32	11/2	3	9/32	11/2	3	5/32	11/2	3	9/32	11/2	3	5/32	11/2	3	....	....	....	....	....	....		15/8	15/8	13/8	15/8	15/8													Ewa†
Waialua	2/3, 2/3	11/3, 11/3, 11/3	11/3, 11/3, 11/3	11/3, 11/3, 11/3	11/0, 22/3, 22/3		3/8	21/4	21/2	....	....	....	3/8	21/4	21/2	....	....	....	3/8	21/4	21/2	5/16	13/4	21/2	3/8	21/4	21/2	5/16	13/4	21/2	....	....	....	....	....	....		15	14 1/2	15	15	15													Waialua
Maui Agr.	2/3, 2 3, 2/3	6, 6, 6	6, 6, 6	6, 6, 6	6, 6, 0		5/16	11/2	3	5/16	11/2	3	5/16	11/2	3	5/16	11/2	3	5/16	11/2	3	5/16	11/2	3	....	....	....	....	....	....	....	....	....	....	....	....		....	....	....	....	....													Maui Agr.
"	2/3, 2 3, 2/3	6, 6, 6	6, 6, 6	6, 6, 6	6, 6, 0		5/16	11/2	3	5/16	11/2	3	5/16	11/2	3	5/16	11/2	3	5/16	11/2	3	5/16	11/2	3	....	....	....	....	....	....	....	....	....	....	....	....		....	....	....	....	....													"
Pioneer	4 9_4/9	1 3/4, 3/4	1, 3, 3	1, 3, 3	3/4, 1, 3	3/4, 3, 3	7/32	13/4	3	7/32	13/4	3	7/32	13/4	3	7/32	13/4	3	7/32	13/4	3	7/32	13/4	3	7/32	13/4	21/4	7/32	13/4	21/4	7/32	13/4	21/4	....	....	....		15/8	15/8	11/2	15/8	15/8													Pioneer
Lihue	Krajewski	3/4, 3, 4, 3/4	3/4, 7, 7	3/4, 7, 7			3/16	11/2	3	3/16	11/2	3	3/16	11/2	3	1/4	11/2	3	1/4	11/2	3	1/4	11/2	3	1/4	11/2	3	....	....	....	....	....	....	....	....	....		14	15	14	13														Lihue
Olaa	Krajewski	2 2/3, 11/3, 6	2 2/3, 11/3, 6	6, 11/3, 6	6, 11/3, 6		1/4	2	3	1/4	11/2	3	1/4	2	3	1/4	11/2	3	1/4	2	3	1/4	11/2	3	1/4	11/2	3	1/4	11/2	3	....	....	....	....	....	....		15/8	14 1/2	13	11 1/2														Olaa
Haw. Sug.	Krajewski	4, 4, 4	4, 4, 4	4, 4, 4	4, 7, 7		3/16	11/2	2	1/8	11/2	2	3/16	11/2	2	1/8	11/2	2	3/16	11/2	2	1/8	11/2	2	....	....	....	....	....	....	....	....	....	....	....	....		11/2	11/2	11/2	13/8														Haw. Sug.
Kekaha	Krajewski	8, 9, 8/9, 8/9	4, 4, 2 2/3	11/3, 2 2/3, 2 2/3	11/0, 2 2/3, 2 2/3	11/3, 4, 4	1/4	2	2	1/4	13/4	3	1/4	2	2	3/16	2	2	1/4	2	2	3/16	2	2	1/4	2	2	3/16	2	2	....	....	....	....	....	....		21/2	2	15/8	11/2	13/8													Kekaha
Honolulu	2/3, 2/3	2/3, 2/3, 2/3	11 3, 11/3, 11/3	11/3, 4, 4	11/0, 4, 4		....	....	....	7/32	11/2	2 3/2	7/32	11/2	3	5/32	11/2	3	5/32	11/2	3	5/32	11/2	3	1/4	11/2	3	....	....	....	....	....	....	....	....		13/4	1 9/16	13/4	15/8														Honolulu
Haw. Agr.	2/3, 2/3, 2/3	11 3, 11/3, 11/3	4, 4, 4	4, 4, 4	5, 5, 7		1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	....	....	....	....	....	....	14	21/2	2	1 1/2	2	1 1/2													Haw. Agr.
Onomea	Krajewski	4, 7, 7	4, 7, 7	4, 7, 7	4, 7, 7		1/4	11/4	2	1/4	11/4	2	1/4	11/4	2	1/4	11/4	2	1/4	11/4	2	1/4	11/4	2	1/4	11/4	2	1/4	11/4	2	....	....	....	....	....	....		11/2	12	12	12 1/2	12													Onomea
Hilo	2/3, 2/5	5, 5, 5	5, 5, 5	5, 5, 5	5, 5, 7		1/4	13/4	2	5/32	11/2	2	1/4	13/4	2	5/32	11/2	2	1/4	13/4	2	5/32	11/2	2	....	....	....	....	....	....	....	....	....	....	....	....		11/8	11/8	13/16	11/8														Hilo
Honokaa	2/3, 2 3, 2/3	11/4, 11/4, 11/4	4, 4, 4	4, 4, 4	5, 5, 7		1/4	11/2	2 1/3	1/4	11/2	2 1/2	1/4	11/2	2 1/3	3/16	11/2	2 1/2	3/16	11/2	2 1/2	1/8	11/2	2 1/2	1/8	11/2	2 1/2	....	....	....	....	....	....	....	....		13/4	11/2	12	12														Honokaa
Makee	Krajewski	11/3, 3, 4	3, 4, 4	4, 4, 4			3/16	2	3	1/8	11/2	3	3/16	2	3	1/8	11/2	3	3/16	2	3	1/8	11/2	3	....	....	....	....	....	....	....	....	....	....	....	....		11/2	11/2	11/2	13/4														Makee
McBryde	1/2, 1/2	4, 4, 4	4, 4, 4	4, 4, 4			1/4	11/2	3	1/4	11/2	2 1/2	1/4	11/2	3	1/4	11/2	2 1/2	1/4	11/2	3	1/4	11/2	2 1/2	....	....	....	....	....	....	....	....	....	....	....	....		13/4	13/8	1 11/16															McBryde
Wailuku	4/5, 4/5	11/3, 11/3, 11/3	11/3, 4, 4	4, 4, 4	4, 4, 4		3/16	13/4	21/4	....	....	....	5/32	13/4	21/4	3/16	13/4	2	1/4	13/4	2	1/4	13/4	2	1/4	13/4	2	....	....	....	....	....	....	....	....		11/2	11/2	11/2	11/2														Wailuku
Kukuku	Krajewski	4, 4, 4	4, 4, 4	4, 4, 4			1/4	13/4	3	1/4	13/4	3	1/4	13/4	3	1/4	13/4	3	1/4	13/4	3	1/4	13/4	3	....	....	....	....	....	....	....	....	....	....	....	....		11/2	11 16	11/8															Kukuku
Hakalau	Krajewski	5, 5, 5	5, 7, 7	5, 7, 7	7, 7, 7		1/4	11/4	2 1/3	3/16	11/2	2 1/2	1/4	11/2	2	1/4	11/2	2 1/2	1/4	11/2	2 1/2	1/4	11/2	2 1/2	1/4	11/2	2 1/2	1/4	11/2	2 1/2	....	....	....	....	....	....		13/8	11 16	1 1/8	11/8														Hakalau
Laupahoehoe	2/3, 2 3, 2/3	4, 4, 4	4, 5, 5	4, 6, 6			3/8	11/2	2 1/2	3/8	11/2	3	1/4	11/2	2 1/2	1/4	11/2	3	3/16	11/2	2 1/2	3/16	11/2	3	....	....	....	....	....	....	....	....	....	....	....	....		15/8	11/8	1 1/16															Laupahoehoe
Waiakea	2/3, 2 3, 2/3	4, 6, 6	4, 6, 6				3/8	11/2	3	3/8	11/2	3	1/4	11/2	3	1/4	11/2	3	3/16	11/2	3	1/8	11/2	3	....	....	....	....	....	....	....	....	....	....	....	....	3 4	11/2	11/4	11/2			12	12 1/2	12 1/2				1 4	1 4	1 4	1 2			Waiakea
Koloa	Krajewski	2 1/3, 2 1/3, 6	2 1/3, 2 1/3, 6	2 1/3, 2 1/3, 6	6, 6, 6		5/16	2	2 5/8	1/4	11/2	2 5/8	5/16	2	2 5/8	5/16	11/2	2 5/8	1/4	2	2 5/8	1/4	11/2	2 5/8	3/16	11/2	2 5/8	....	....	....	....	....	....	....	....		11 4	11 4	11 4	11 4														Koloa
Hutchinson	2/3, 2/3, 2/3	4, 4, 4	4, 4, 4				5/32	13/4	2	5/32	13/4	2	5/32	13/4	2	5/32	13/4	2	5/32	13/4	2	5/32	13/4	2	3/16	13/4	2	1/8	13/4	2	....	....	....	....	....	....	15 16	11 10	13/16	7 8			11	12 7 8	12 3/4	13 1/2			1 4	1 4	1 4	1 2	1 4		Hutchinson
Hawi Mill	3/8, 3/8	2, 2, 2	2, 4, 4	4, 4, 4	4, 4, 4		1/4	13/4	2	3/16	13/4	2	3/16	13/4	2	3/16	13/4	2	3/16	13/4	2	1/8	13/4	2	3/16	13/4	2	1/8	13/4	2	....	....	....	....	....	....		11 2	11 4	11 2	11				12	12	12				2	2	2			Hawi Mill
Hamakua	Krajewski	6, 6, 6	6, 6, 6	6, 6, 6	6, 6, 6		1/4	11/2	3	5/32	11/2	2	1/4	11/2	3	5/32	11/2	2	1/4	11/2	3	5/32	11/2	2	3/16	11/2	2 1 4	3 16	11/2	2 1/4	....	....	....	....	....	....		11 2	11 3 4	11 1 2	12				12	12	12				1 2	2	2			Hamakua
Pepeekeo	Krajewski	7, 4, 7	7, 7, 7	7, 7, 7			1/4	11/2	3	1/4	11/2	3	5/32	11/2	2	1/4	11/2	3	5/32	11/2	2	1/4	11/2	3	5/32	11/2	2	1/4	11/2	3	....	....	....	....	....	....		13/8	13/8	1 3/8					14	13	13				2 3 4	3	3			Pepeekeo
Paauhau	Krajewski	2 2/3, 4, 4	6, 7, 7	7, 7, 7	7, 7, 7		9/64	11/2	2	9/64	11/4	2	3/16	11/2	2	3/16	11/4	2	9/64	11/2	2	9/64	11/4	2	9/64	11/2	2	9/64	11/4	2	....	....	....	....	....	....		15/32	1	1	3 4				11 2	11 1 4	12 5 8	12								Paauhau
Kohala Mill	2/3, 2/3, 2/3	5, 5, 5	5, 5, 5				7/32	11/2	2 1/2	7/32	13/4	2 1/2	9/32	13/4	2 1/2	7/32	13/8	2 1/2	7/32	11/2	2 1/2	7/32	13/8	2 1/2	....	....	....	....	....	....	....	....	....	....	....	....	1 1 2	15/8	15/8				1 1 2	12	12 1 4										Kohala Mill
Honomu	2/3, 2/3, 2/3	6, 6, 6	6, 6, 6				5/32	13/4	2	5/32	13/4	2	5/32	13/4	2	5/32	13/4	2	5/32	13/4	2	5/32	13/4	2	....	....	....	....	....	....	....	....	....	....	....	....		11/8	7 8	3 4				12	12 1 4	12 1 4										Honomu
Kaiwiki	Krajewski	3, 6, 6	6, 6, 6	6, 6, 6			1/4	11/2	3	3/16	11/2	3	1/4	11/2	3	3/16	11/2	3	1/4	11/2	3	3/16	11/2	3	....	....	....	....	....	....	....	....	....	....	....	....		13/8	11 4	1 1 8					12 1 2	11	12									Kaiwiki
Waimanalo	4/5, 4/5, 4/5	2, 4, 4	4, 4, 4	4, 4, 4			5/16	11/2	2	5/16	11/2	2	1/4	11/2	2	5/32	11/2	2	5/32	11/2	2	5/32	11/2	2	....	....	....	....	....	....	....	....	....	....	....	....	1	11/4	11/4				1 2 1 16	13 1 2	13 1 2				2 8	2 8	2 8				Waimanalo
Kilauea	8/9, 8/9, 8/9	4, 4, 4	4, 4, 4	4, 4, 4			1/2	15/8	2	3/8	15/8	2	5/8	15/8	2	3/8	15/8	3	3/8	15/8	3	5/16	15/8	3	....	....	....	....	....	....	....	....	....	....	....	....	2	11/4	13 8	2 3 16			11	13	12	12 1 2			1	1	1	1			Kilauea
Waianae	1, 1, 1	2, 4, 4	3, 4, 4	4, 4, 4			1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	1/4	11/2	2	....	....	....	....	....	....	....	....	....	....	....	....	15/8	11/2	13 8				12	12 1 4	12 3 4				3 4	1	1				Waianae
Union Mill	2/3, 2/3, 2/3	2 1/2, 2, 5	3, 6, 6				5/16	15/8	3	7/32	11/2	3	9/32	11/2	3	5/32	11/2	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	11 2	11 4	1				11	11 1 2											Union Mill
Kaeleku	Krajewski	3, 3, 3	3, 3, 3	5, 5, 5			1/8	11/4	2	1/8	11/4	2	1/8	11/4	2	1/8	11/4	2	1/8	11/4	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....		11 2	11 4	1					13	12 1 2	12 1 8									Kaeleku
Niulii		2, 2, 2	5, 5, 5	5, 5, 5			1/4	11/2	3	1/8	11/2	2	1/4	11/2	3	1/8	11/2	2	1/4	11/2	3	1/4	11/2	3	....	....	....	....	....	....	....	....	....	....	....	....		13/4	13 8	2					12 1 2	12 7 8	12									Niulii
Waimea	Krajewski	8/9, 8/9, 8/9	4, 4, 8	4, 8, 8	4, 8, 8		....	....	....	....	....	....	1/4	11/2	1 1/2	1/8	11/2	1 1/2	1/4	11/2	1 1/2	1/8	11/2	1 1/2	1/4	11/2	1 1/2	1/8	11/2	1 1/2	....	....	....	....	....	....		11/2	1	1	1				8	11	11	11				1 1 4	1 1 4	1 1 4	1 4		Waimea

* Measurements in Inches.

† Ewa 6th Mill; Surface grooves, 1 1/3, 5 1/3, 5 1/3, Juice grooves, Front 9/32, 1 1/2, 3, Back 5/32, 1 1/2, 3, Returner Bar from top roller, Center, 1 1/2, Width 12 1/2, Distance from back roller, 3/4.

LOW GRADE MASSECUITE EQUIPMENT DATA—CROP OF 1934

FACTORY	Approx. Tons Cane Hour	LOW GRADE MASSECUITE: Cubic Feet: Per Ton Cane	LOW GRADE MASSECUITE: Cubic Feet: Per Hour	LOW GRADE MASSECUITE: Brix Orig.	LOW GRADE MASSECUITE: Brix When Dried	CRYSTALLIZERS: Wk'g Cap. Cu. Ft. T. C. H.	CRYSTALLIZERS: Coils: Type	CRYSTALLIZERS: Coils: Sq. Ft./ Cu. Ft.	CRYSTALLIZERS: Age Mass. Hours	CRYSTALLIZERS: Hours Cooling	CRYSTALLIZERS: Hours Heating	CRYSTALLIZERS: Mass. From Pan F°	CRYSTALLIZERS: Temperature Massecuite F°: Cooled	CRYSTALLIZERS: Temperature Massecuite F°: Heated	CRYSTALLIZERS: Heating Water F°: In	CRYSTALLIZERS: Heating Water F°: Out	HEATERS IN TROUGHS: Cu. Ft. Per Hour	HEATERS IN TROUGHS: Coils Sq. Ft. H. S.	HEATERS IN TROUGHS: Sq. Ft./ Cu. Ft./ Hour	HEATERS IN TROUGHS: Type	HEATERS IN TROUGHS: Coils R. P. M.	HEATERS IN TROUGHS: Mass. F° Out	HEATERS IN TROUGHS: Heating Water F°: In	HEATERS IN TROUGHS: Heating Water F°: Out	INDEPENDENT HEATERS: Cu. Ft. Per Hour	INDEPENDENT HEATERS: Sq. Ft. H. S.	INDEPENDENT HEATERS: Sq. Ft./ Cu. Ft./ Hour	INDEPENDENT HEATERS: Type	INDEPENDENT HEATERS: Coils R. P. M.	INDEPENDENT HEATERS: Mass. F° Out	INDEPENDENT HEATERS: Heating Water F°: In	INDEPENDENT HEATERS: Heating Water F°: Out	HEATERS IN CENTRIFUGALS' MIXERS: Cu. Ft. Per Hour	HEATERS IN CENTRIFUGALS' MIXERS: Sq. Ft. H. S.	HEATERS IN CENTRIFUGALS' MIXERS: Sq. Ft./ Cu. Ft./ Hour	HEATERS IN CENTRIFUGALS' MIXERS: Type	HEATERS IN CENTRIFUGALS' MIXERS: Coils R. P. M.	HEATERS IN CENTRIFUGALS' MIXERS: Mass. F° Out	HEATERS IN CENTRIFUGALS' MIXERS: Heating Water F°: In	HEATERS IN CENTRIFUGALS' MIXERS: Heating Water F°: Out	CENTRIFUGAL MACHINES: Baskets: No. & Dia."	CENTRIFUGAL MACHINES: Baskets: R. P. M.	CENTRIFUGAL MACHINES: Cent. Force	CENTRIFUGAL MACHINES: Drying Cycle Time (Minutes)	CENTRIFUGAL MACHINES: Mass. F° at Start	CENTRIFUGAL MACHINES: Sugar F° at Finish	CENTRIFUGAL MACHINES: Steam Used	CENTRIFUGAL MACHINES: Top or Bottom Covers	CENTRIFUGAL MACHINES: Mass. Bat'n Temp. F°	CENTRIFUGAL MACHINES: Molasses Viscosity Tests: Temp. F°	CENTRIFUGAL MACHINES: Molasses Viscosity Tests: Poises	Date Mill Has Been Started	FACTORY
H. C. & S. Co.	123	1.20	150	100	98.5	256	None	...	198	192	...		85-90																							44-40	1000	366										H. C. & S. Co.
Oahu	120	1.36	163	98.4	98.4	170	S	.36	108	57	51	150	91	114	120-140			None																			4-40	1200	358										Oahu
Ewa	95	1.33	119	100	100	161	S	.43	90	60	30	160	95	105-110	130	125		None																			105.5	1097										Ewa
Wailua	91.5	1.55	142	101	97.5	245	S	.40	120	120	...	140	104	...				None																			95.5	538										Wailua
Pioneer	82	1.47	120	98.3	94.5	209	R	.06	120	96-120	[4]18	145	83	95	145			None									120	[5]548	4.57	T	...	114	126	119	163	150	.92	S	...	114	125		16-42	1200	859	50	114	108	No	None	110-120†	119	702	Crop 1930	Oahu
Oloa	100	1.25	125	99	97-98	162	S R	.22 .05	96	96	...	140	90	...				None																	[7] 13 [7] 32.5	116 208	8.92 6.40	R R	3.5	116	113	112	15-40 [4] 8-40 3-40	1160 1710 1880	765 1660 1083	70 70 45	110 110 104	105-110 107	No Yes No	None None	110-117	113 104	521 711	Jan. '34	Ewa
Kekaha	61	1.34	82	99-100	98.5-99.5	207	R	.12	108	100	8	150—	85-90	100-105	150	140		None									82	262	3.20	R	1.3	115	135-140	120	82	350	4.27	S	...	120-125	135-140	120	[7] 40 16-40	[5]250 1000	6.25 627	R	3	...			15-40 16-40	1150 1175	752 785	45 90	110 114	109	No No	None None	117 115-125	110 118	724 853	Mar. '35 1932	Waialua Kekaha
Honolulu	50	1.50	75	99.4	99.4		R	.19	144	48	[4]96	140	86	115	128	116	[4]	34.5		S	...	115	125	115	[4]	None 99		R	3	115	125	122	4-42 11-40 5-40	1093 1093 1275	713 679 924	90	115	110	No	Both	118	112	832	Exp't'l	Honolulu
Haw. Agr.	59	1.10	55	98-100	99-95	48	[3]	[3]	30	30	None	140	110					None									55	156	2.84	S	...	124	132	130	7-40	1200	818	60	123	123	Yes	Both	96-104	97.5	1056	June '34	Haw. Agr.
Onomea	55	.85	44	99	99	131	S	.15	120	60	60	148	92	105	125	118		None									44	140	14.55	T	...	125	125	125	44	136	3.09	S	...	120	125	125	10-40	1000	818	120	120	120	No	Both	110-115	100 ans	1076 sec	Apr. '34	Onomea
Hilo	50	1.06	53	98.7	98.7	104	S	.36	90	60	30	148	85	115	129	128		None									53	588	11.09	T	...	126	129	128	53	418	7.88	S	...	119	129	128	12-40 [5]12-40	950 [5]	513 [6]	60	124	119	Yes	Both	115-120	120 92.5	291 785	1933	Hilo
Honokaa	55	1.89	100	96.5	95.0	145	None	...	72-80	72-80	...	155	95-105					None									35	150	4.30	B	...	106	115-120	110-112	[4] 47	25	.50	S	...	98-106	110	103	2-30†	1100	511	45	95-100	100	No	None	115-125	90	758	Apr. '34	Honokaa
McBryde	47	1.27	55	101.5	94-96	192	R S	.06 .14	192	192	...	152	80	...				None									55	[7]690	12.55	T	...				55	[7]555	1[illegible].01	S	...				1-40 [3] C-40	1200 1200	818 613	60	123	123	Yes	Both	96-104	97.5 95	1056 1026	June '34	Haw. Agr.
Waiuku	50	1.35	68	99.5	98.5	228	None	...	168	168	...	140	85					None																	[7] 27	116	4.30	R	3.25	107	132	122	9-40	1125	719	60	107	104	No	Top	105-115	114.6	88[illegible]	[illegible]	[illegible]
Kahuku	40	1.04	42	99.4	97.5	122	S	.19	120	96	24	140	82	92	122	120		None									42	[8]816	19.4	T	...				17	238	14.00	S	...	108	123	122	20-30 6-30	1400 [6]1400	836 1114	30	108	101	No	None	115-120	93.2	636	Jan. '33	Kahuku
Hakalau	40	1.25	50	99.5	99.5	260	None	...	144	144	...	150	86	...			50	250	5.00	S	...	102	125	120	50	300	6.00	T	...	120	125	120	50	268	5.36	S	...	122	125	122	6-40 6-40	1200 1200	818 818	80	122	122+	No	Top	120-122		[illegible]	[illegible]	[illegible]
Laupahoehoe	40	1.03	41	98.4	98.0	193	S	.14	84	48	36	145	88	105	140	120-130	41	70 [8]80	1.71 1.90	S S	... ...	100-110 85	140 127	120-130 125		None									[7] 41	605	14.76	S	...	116-124	140	120-130	4-40	1100	688	45	120	119	Yes	Top	118-126	104	595	Mar. '34	Laupahoehoe
Waiakea	32	1.30	42	98.5	97.0	263 140	S S	[3].12 .09	100	100	...	160	80	...			42	50	1.20	R	...	.....	...	...	42	55	1.31	R	5	109	133	127	42	85	2.02	S	...	105	135	132	6-40 79	1025 [illegible]	597 [illegible]	45-60	105	110	Yes	None	Ab't 105	102 [illegible]	1164 [illegible]	Dec. '33	Waiakea
Kolea	40	1.05	42	100	†	11	R	.36	120	120	...	140	87	...			42	[8]822	12.43	T	...				42	[8]822	12.43	T	...				[8]								16-30	1200	614	60	85-88	...	No	None	118-†	105.5	325	For '35	[illegible]
Hutchinson	35	1.00	35	100-102	100-102	[3]114	None	...	96	96	...	155	78-85				35	30	.86	R	2	100	130	124	35	157	4.49	T	...	120	130	125	35	100	2.86	R	5	124-125	150	127	7-40	1100	685	60	125	122	No	Top	118-†	111	1[illegible]	[illegible]	[illegible]
Hawi Mill	35	1.77	62	98.6	98.4	194	None	...	212	212	...	152	90	...			50	650	13.00	S	...	109	140	112		None							50	507	10.14	S	...	124	140	128	8-40 14-30	1200 1225	818 750	60	124	120	No	Top	128-130	110	454	May '34	Hawi Mill
Hamakua	32	1.22	39	97.5	96.5	125	S	.29	108	108	...	150	85	...				None							39	...	Baffl'd	Tower	...	95	Steam	...	[7] 20	213	10.65	S	...	95-98	100	95-98	2-40	1130	726	60	95-98	90	[3] Yes	None	95-100	88 88	623 961	May '34	Hamakua
Pepeekeo	32	.94	30	100.5	99.3	155	S	.12	120	72	48	148	94	96	120	120	30	87	2.90	S	...				30	500	16.67	T	...	108†	120	117	30	184	6.13	S	...	116	120	120	10-40	950	513	120	110	108	No	Both	110-125	122	636	May '34	Pepeekeo
Paauhau	26	1.35	35	96.5	96.5	100	R	.17	60	48	12	155	100	105	145	130		None							35	125	3.57	S	...	127	145	140	8-40	1150	791	60	127	125	[3] Yes	Top	130	104.5	839	Dec. '33	Paauhau
Kohala Mill	30	1.60	48	97.7		217	S	[3]	274	274	...	143	†	...				None							31	381	12.29	S											6-30	1275	989							93.4	1512		
Honomu	25	1.01	25	97.5	97.0	170	None	...	144	144	...	155	82				25	123	4.92	T	...	108	135	127	25	287	11.48	S	...	110	127	127	11-30	1175	764	90	108	105	Yes	None	120	85	731	Dec. '33	Honomu
Kaiwiki	30	1.25	38			[4] 135	R	.23									[4] 38	335	8.81	R					[4] 38	230	6.05	R					[4] 60-80	1300	1435												Kaiwiki
Waimanalo	27.5	1.32	36	99.7	99.7	306	None	...	227	227	...	156	85				36	50	1.39	R	4	114	135	172	36	290	8.55	S	...	115	132	130	10-40	1250	826	60	115	110	Yes	None	118-†	97.5	1[illegible]	[illegible]	[illegible]
Kilauea	27	1.70	46	97-101	94-97	140	S	.12	72	72	...	158	94	...			46	93	2.02	R	5	120	150	148	46	105	2.28	S		119	150	150	8-40	1150	790	45	116	114	Yes	None	118-†	111	1[illegible]	[illegible]	[illegible]
Waianae	28.5	1.06	30	100	97	115	R	.12	139	98	41	143	87	99	111	106	[3]82	44	3.00	S	...	100	106	106	22	64	2.91	S		109	110	110	[7] 4-30	1200	767	60	109	106	Yes	None	120	116	1[illegible]	[illegible]	[illegible]
Union Mill	25	1.20	30	98	96	144	S	.41	312	312	...	140	85	...			30	98	3.27	T	...	90-100	113	115	30	273	9.10	S		104	115	114	12-30	1380	810	45	104	101	Yes	None	118-†	96	1[illegible]	[illegible]	[illegible]

S—Stationary coils
R—Revolving coils

T—Tubular (Juice type)
B—Box (vertical) stationary coils

[1]—Proposed for 1935
[2]—All mixers

[3]—Water Jacket
[4]—Experimental only

[5]—For half capacity
[6]—45% massecuites heated. Independent heater takes 75% of this.

[7]—Heated massecuite only
[8]—Being installed

[9]—To be replaced
[10]—At times

[11]—Also heated air at 150° F.
[12]—Grinds one shift but dries two shifts

[13]—Coils not working

[14]—For 1935

[15]—6 at 1200, 6 at 975
[16]—6 at 815, 6 at 540

FACTORY EQUIPMENT—INCLUDES IMPROVEMENTS FOR THE 1935 CROP

DATA BASED ON TONS CANE PER HOUR RATED CAPACITY

Factory	Capacity T. C. H.		MILLING PLANT (Sizes in Inches—No. of Units in parentheses)	MILL ENGINES	BOILERS [5] Sq. Ft.		FURNACES					STACKS (Dimensions Only)				GENERATORS			JUICE HEATERS Sq. Ft.			SETTLERS Cu. Ft.		FILTERS Sq. Ft.		EVAPORATORS Sq. Ft.				PAN SUPPLY TANKS Cu. Ft.		VACUUM PANS			VACUUM PUMPS		LOW GRADE CRYSTALLIZERS Working Capacity			MASSECUITE TANKS	CENTRIFUGALS Screen Area Sq. Ft.			Factory
	Rated Capacity	Capacity at 2.0 Tonnage Ratio		Diameter x Stroke (No. of rollers in parentheses)	Water Tube	Fire Tube	Grate Area sq. ft.	Tuyeres sq. ft.	Primary Combustion Volume, cu. ft.		Total Combustion Volume, cu. ft.		Dia. at Top, ft.	Height, ft.	Dia. at Top, ft.	Height, ft.	K. V. A.	K. W. used in Factory	K. W. used Outside	Mixed Juice Baffled	Mixed Juice Unbaffled	Clarified Juice	Intermittent	Continuous	Plate and Frame	Continuous, Oliver	Pre-evaporator Baffled	Pre-evaporator Unbaffled	Triple	Quadruple Baffled	Quadruple Unbaffled	Syrup and Brunix	Molasses	Commercial Sugar		Low Grade		Total		Main Pumps cu. ft. per Minute	Auxiliaries cu. ft. per Minute	Without Coils	With Coils		Low Grade	Commercial Sugar	Low Grade	Total	
									Water Tube	Fire Tube	Water Tube	Fire Tube																						Cu. ft.	Sq. ft.	Cu. ft.	Sq. ft.	Cu. ft.	Sq. ft.			Cu. ft.	Cu. ft.	Sq. ft. per cu. ft. Capacity	Cu. ft.				
Tentative Standards [1]					375	450														20	35		80	65	120	8	40	48	225	250	300	50	50	40	40–55	20	20–30	60	60–85			300	150			2.0	5.0	7.0	Tentative [1] Standards
H. C. & S. Co. [2]	140	140.8	K(4),2RC78(2),S72(2),12RM78(2)	16x36(2),28x60(9),22x48(3)	56.9	326.6	3.1	.38	7.7	25.7	26.8	107.7	12	180	12	180	10.7	11.0	2.7	21.9	26.5	...	...	[5]106.3	...	6.4	...	38	...	...	265	48.3	30.6	42.9	44.2	37.1	31.8	80.0	76.0	40.9	...	274.3	....	....	....	1.65	7.18	8.83	H. C. & S. Co. [2]
Oahu [3]	145	140.8	K(2),2RC78(2),S72(2),12RM78(2)	24x48(5),30x60(9)	323.0	....	2.2	....	19.6	....	52.9	....	10	231	10	173	23.8	6.7	4.3	28.3	....	....	....	[5]63.0	....	8.3	....	....	....	238 v_1	....	23.7	39.4	25.5	26.2	18.4	19.9	45.0	45.1	38.6	1.6	....	140.7	.26	....	....	1.16	2.02	3.18	Oahu [3]
Ewa	100	98.6	K(2),2RC78,18RM78	30x60(11),30x54(9)	411.7	....	5.9	.12	51.2	....	118.4	....	7	137	8	150	50.0	7.0	23.0	22.4	....	....	100.9	....	....	6.0	....	....	....	....	260 v_1	....	48.3	47.1	30.2	27.9	19.9	20.0	50.1	47.9	28.3	0.0	....	153.0	.47	....	4.82	6.50	Ewa
Waialua	100	84.5	K(2),2RC78,15RM78	26x54(5),30x60(9),22x48(3)	404.4	....	3.5	.51	88.5	....	125.3	....	$11\frac{1}{2}$	185	..	..	35.0	7.0	26.0	47.4	....	....	96.9	....	....	....	....	....	....	....	289 v_1,v_4	....	30.3	45.5	44.4	41.0	17.3	26.3	61.7	67.3	45.2	18.4	108.0	78.8	.40	....	1.47	3.77	5.24	Waialua
Maui Agr. [2]	110	100.8	K(4),3RC66(2),12RM66(2)	28x42(6),28x48(9)	362.2	....	[4]1.1	.43	6.4	....	48.3	....	10	120	..	..	47.7	7.3	20.9	35.0	....	12.4	....	[6][8] 94.6	....	....	....	82	....	....	231	....	52.2	33.0	33.4	67.8	30.5	37.9	63.9	105.7	46.3	....	185.0	108.7	.17	....	1.14	2.82	3.96	Maui Agr. [2]
Pioneer	90	72.0	K,2RC72,S72,15RM72	16x36(2),26x42(6),28x54(9)	325.5	98.2	6.8	.38	49.9	12.7	115.5	46.2	12	225	..	..	11.1	6.7	3.3	24.9	20.0	....	80.2	....	71.1	....	....	....	....	267 v_3	41.9	40.0	41.7	45.4	25.6	33.1	67.3	78.5	45.9	....	17.8	191.7	.05	....	2.79	3.72	6.51	Pioneer
Lihue [3]	140	118.4	K,2RC78,S72,12RM78[3]	18x42(2),28x54(6),28x48(6)[4]	224.3	125.9	3.2	.12	21.8	9.7	69.3	40.1	12	180	..	..	6.7	2.9	2.9	37.1	5.4	....	....	[5] 71.8	44.7	4.3	....	....	....	250 v_1,v_2	....	52.7	52.7	41.4	55.6	25.7	29.2	67.1	84.8	27.6	....	....	180.0	.17	....	1.44	4.34	5.78	Lihue [3]
Olaa	95	70.4	K,2RC78,S72,12RM78	18x42(2),26x48(2),28½x60(9)	80.8	215.9	4.0	.27	6.9	26.0	14.8	93.5	$9\frac{1}{2}$	130	..	..	10.5	8.4	....	21.5	13.3	....	75.7	....	6.3	....	....	....	....	220 v_2	25.3	59.6	29.5	29.5	28.4	42.1	57.9	71.6	36.8	5.4	....	170.5	.11	....	1.32	3.97	5.29	Olaa
Haw. Sug.	65	70.4	K,2RC72,S72,12RM78	20x42(2),28x54(6),28x54(6)	227.8	161.2	5.2	....	15.1	4.2	30.8	56.0	5	154	..	..	21.5	....	....	23.1	....	....	....	[5] 64.6	91.4	....	....	....	....	206	35.4	48.8	41.2	51.9	23.1	23.4	64.3	75.3	67.6	....	92.3	92.3	.23	....	1.93	5.32	7.25	Haw. Sug.
Kekaha	65	50.0	K(2),2RC54,15RM60	16x32(2),28x54(9),24x54(6)	189.0	195.4	4.6	.21	18.0	13.5	72.2	92.2	10	200	..	..	28.8	6.9	16.2	32.6	9.2	....	....	[5] 62.8	....	6.9	....	90	....	....	192	34.2	49.5	34.8	41.1	13.8	19.2	48.6	60.3	43.5	....	122.1	98.4	.02	....	1.93	3.87	5.80	Kekaha
Honolulu	60	70.4	K(2),2RC78,12RM78	28x48(5),28 11/16x60(9)	509.2	....	6.0	.78	41.7	....	112.5	....	9	180	..	....	25.0	13.7	8.6	23.3	....	11.7	....	[5] 50.0	[6] 80.3	....	....	83	....	....	....	251 [6],v_1	95.9	57.6	[6]60.0	[5]113.8	30.3	44.4	90.3	158.2	8.8 [6]	....	360.1	22.7	.16	....	3.84[5]	5.06	8.90	Honolulu
Haw. Agr.	55	50.4	K(2),2RC60,12RM66	24x48(6),26x54(9)	428.1	....	4.7	.71	33.3	....	44.3	....	$5\frac{1}{2}$	110	$5\frac{1}{2}$	125	11.4	....	....	43.0	....	12.2	102.8	....	110.9	....	....	91 v	....	....	327 v_2	....	32.7	52.3	33.4	31.5	21.8	22.5	55.2	54.0	57.4	....	47.8	....	....	292.8	3.05	4.57	7.62	Haw. Agr.
Onomea	55	50.4	K,2RC60,S54,12RM66	22x42(5),28x60(9)	231.5	89.5	3.1	.85	19.8	10.0	42.6	11.8	$6\frac{1}{2}$	170	..	..	11.4	5.5	.5	25.8	....	....	61.7	....	82.5	....	....	....	....	....	291 v_1	25.8	27.8	34.0	37.3	16.0	13.0	50.0	50.3	39.9	11.0	....	130.9	.13	....	2.28	3.81	6.09	Onomea
Hilo	50	50.4	K'(2),2RC66,12RM66	26x54(11),22x42(3)	294.9	....	[2]2.7	.28	38.4	....	99.4	....	7	143	..	..	....	....	....	47.3	....	....	78.0	....	120.8	....	....	....	....	373 v_1,v_2	33.6	50.4	30.4	35.6	15.0	25.0	45.4	60.6	18.0	....	....	104.0	.35	....	2.51	5.02	7.53	Hilo
Honokaa	60	50.4	K(2),3RC66,12RM66	22x42(3),26x54(9),20x42(3)	308.7	254.0	3.8	.01	5.8	12.0	19.4	21.3	7	179	..	..	....	....	....	21.0	....	....	135.0	....	....	5.0	65	....	....	194	21.7	35.0	33.3	39.7	22.5	21.2	55.8	60.9	21.8	....	133.3	....	....	....	2.09	7.24	9.33	Honokaa
McBryde	50	65.2	K,2RC72,S72,9RM84	24x48(5),28x48(6)	364.4	....	[2]2.2	.22	31.9	....	48.4	....	$10\frac{1}{2}$	225	..	..	25.0	11.0	10.0	36.4	....	....	....	[5] 80.8	....	6.0	74	....	....	....	....	64.8	65.9	40.0	48.0	36.0	35.0	76.0	83.0	106.9	....	58.1	121.9	.16	....	1.68	5.03	6.71	McBryde
Wailuku	50	70.4	K,2RC72,12RM78	23x54(6),28x60(9)	241.3	152.4	4.2	.68	20.7	14.5	35.5	41.8	8	140	..	..	8.5	....	....	24.0	....	....	118.0	....	133.3	....	....	81	....	230	54.0	42.8	29.0	35.0	27.0	28.5	55.0	63.5	25.7	....	229.5	....	....	....	1.68	6.28	7.96	Wailuku
Kahuku	45	48.0	K,2RC60,S54,9RM72	14x36(2),28x48(9)	239.8	169.3	3.8	.17	19.4	15.6	45.0	73.2	8	150	..	..	16.7	7.8	6.7	24.9	....	....	78.2	....	133.3	....	....	....	....	304 v_3	24.0	56.7	43.5	39.5	19.6	24.0	63.1	63.5	18.5	....	....	144.4	.19	....	1.86	4.07	5.93	Kahuku
Hakalau	35	41.7	2RC54,12RM9-60,3-66	26x54(11),18x42(3)	344.7	145.1	6.9	.24	20.1	9.2	34.5	54.0	5	245	..	..	....	....	....	20.3	15.9	....	96.6	....	118.7	....	....	86	....	287	47.3	36.7	35.6	36.5	21.0	22.2	56.6	58.7	33.0	....	241.3	....	....	....	2.39	7.18	9.57	Hakalau
Laupahoehoe	40	33.3	K,3RC60,9RM60	24x54(6),24x56(6)	246.8	190.5	3.4	.31	44.4	20.0	192.4	24.8	$6\frac{1}{2}$	150	..	..	2.0	....	....	38.5	....	....	66.3	....	87.5	....	....	....	....	328 v,v_1,v_2	35.9	47.2	35.0	40.0	40.0	56.8	75.0	96.8	67.7	....	....	192.5	.14	....	2.09	6.22	8.31	Laupahoehoe
Waiakea	35	33.3	K,3RC60,9RM60	22x42(3),26x54(9)	368.8	....	3.7	.58	9.6	....	81.5	....	8	120	..	..	14.2	8.3	....	20.3	....	....	....	[5] 60.0	....	8.6	....	....	....	283	31.4	45.3	43.4	65.4	20.6	24.5	64.0	89.9	62.7	....	....	240.0	.12	....	2.39	3.59	5.98	Waiakea
Kolon	40	50.4	K,2RC60,12RM66	24x48(8),24x48(6)	....	311.8	4.5	.13	....	13.1	....	116.3	6	120	..	..	1.9	1.8	....	31.5	13.1	....	....	[5] 83.8	....	5.6	....	....	....	233 v_1	36.6	45.8	27.5	29.0	25.0	22.5	52.5	51.5	20.2	....	....	159.4	.13	....	3.14	3.67	6.81	Kolon
Hutchinson	35	33.3	K'(3),2RC60,9RM60	22x42(3),26x54(9)	282.0	146.3	4.4	.41	25.1	12.3	51.0	76.7	6	140	..	..	14.3	8.2	1.7	23.7	16.6	19.4	63.2	....	....	....	....	....	....	357 v_1,v_2	34.2	79.9	22.9	38.9	22.9	27.3	45.8	66.2	47.4	....	228.6	....	....	....	2.39	4.19	6.58	Hutchinson
Hawi Mill	35	33.8	K(2),2RC54,12RM54	18x36(5),24x54(9)	205.7	196.2	4.3	.04	26.7	15.5	74.3	53.1	6	105	6	105	17.9	8.6	8.6	40.0	....	....	125.8	....	....	8.6	125	229	....	....	54.0	74.3	38.9	37.4	34.4	33.3	53.3	55.7	34.3	....	216.1	....	....	....	3.59	4.79	8.38	Hawi Mill
Hamakua	30	41.7	K,2RC60,12RM60	22x42(5),26x54(9)	....	423.3	4.0	.19	....	14.4	....	97.6	7	145	..	..	7.5	4.0	1.2	38.8	....	....	....	[5][9]121.8	....	....	....	....	....	337	41.0	49.5	42.5	43.4	14.2	11.0	56.7	54.4	30.3	....	....	133.3	.29	480.3	2.79	5.67	8.46	Hamakua
Pepeekeo	35	33.3	2RC54,9RM60	26x54(11)	125.3	217.7	4.0	.52	20.2	27.3	41.7	82.1	$7\frac{1}{2}$	130	..	..	....	....	....	20.7	....	20.0	....	....	42.9	100.0	....	....	....	....	249 v_1	27.1	25.7	33.4	32.5	27.9	37.5	61.3	70.0	20.2	....	60.0	91.4	.16	....	2.39	4.79	7.18	Pepeekeo
Paauhau	30	50.4	2RC60,12RM66	20x48(5),26x54(9)	205.1	190.5	5.4	.87	25 3	20.7	70.2	87.1	$5\frac{3}{4}$	110	..	..	....	....	....	17.2	11.7	....	90.9	....	141.3	....	....	....	....	281	16.3	57.0	35.3	43.8	20.0	22.5	55.3	66.3	22.1 [6]	....	....	100.0	.17	....	2.79	4.19	6.98	Paauhau
Kohala Mill	30	33.3	K(2),3RC60,9RM60	22x48(6),24x48(6)	488.6	....	5.6	.10	50.2	....	72.6	....	6	138	..	..	41.7	3.3	26.7	....	26.7	....	86.1	....	....	10.0	....	248	....	....	281	45.1	89.3	38.0	39.8	15.9	20.4	53.9	60.2	42.3	....	216.7	....	....	299.2	4.97	7.06	Kohala Mill
Honomu	25	33.3	3RC60,9RM60	22x42(3),24x48(9)	88.9	228.6	3.6	.03	5.9	8.3	16.6	51.3	$6\frac{3}{4}$	120	..	..	....	....	....	12.8	....	....	66.0	....	41.3	11.0	72	....	....	....	221	41.0	31.0	26.0	25.3	12.0	15.1	38.0	40.4	39.6	....	170.0	....	....	....	3.35	5.13	8.48	Honomu
Kaiwiki	30	33.3	K,2RC60,9RM60	16x36(2),24x54(9)	....	338.7	5.0	....	....	18.7	....	51.5	6	100	..	..	....	....	....	....	17.9	6.0	79.5	....	....	10.0	....	....	....	202 v_1	17.6	33.2	39.7	58.1	20.0	28.0	59.7	86.1	70.9	....	....	140.0	.23	....	1.20	4.20	5.40	Kaiwiki
Waimanalo	25	27.0	K,3RC54,9RM54	20x42(6),20x42(6)	313.5	....	5.2	.77	45.6	....	76.5	....	$6\frac{1}{2}$	140	..	..	15.0	....	....	....	38.9	....	91.0	....	176.6	....	....	....	....	321 v_1,v_3	31.2	69.0	48.0	48.0	24.0	24.0	72.0	72.0	87.4	21.0	336.0	....	....	....	3.35	5.03	8.38	Waimanalo
Kilauea	30	33.3	K,3RC60,9RM60	18x42(3),24x54(9)	201.1	169.3	4.8	.27	22.8	18.4	56.9	65.1	$6\frac{1}{2}$	97	..	..	....	....	....	18.2	....	....	88.0	....	144.2	....	73	....	....	171	39.5	43.3	26.7	39.7	21.7	36.5	58.4	76.2	48.3	....	....	130.0	.12	352.3	2.79	5.58	8.37	Kilauea
Waianae	30	33.3	K(2),3RC60,9RM60	24x42(9),20x42(3)	....	338.7	4.4	.28	....	32.8	....	121.3	7	126	..	..	....	....	....	26.7	....	....	80.0	....	154.1	....	....	....	....	234 v_2,v_3	30.0	40.7	26.8	29.3	25.0	24.0	51.8	53.3	26.4	....	....	110.0	.13	....	2.09	2.09	4.18	Waianae
Union Mill	25	25.0	K,3RC60,6RM60	18x42(3),24x48(6)	....	321.0	3.2	.13	....	21.4	....	111.6	6	135	..	..	....	....	....	....	28.0	....	60.1	....	149.6	....	....	....	....	194 v_1,v_4	41.4	42.6	36.0	55.3	14.4	24.2	50.4	79.5	87.4	....	....	144.0	.41	....	3.35	4.40	7.75	Union Mill
Kaeleku	30	33.3	K,2RC54,9RM60	14x36(2),26x54(9)	....	338.7	4.0	....	....	5.1	....	35.3	5	105	..	..	....	....	....	....	39.9	....	76.8	....	102.7	....	....	....	....	225 v_1,v_4	40.0	26.7	26.7	31.7	13.3	12.7	40.0	44.4	57.5	....	....	....	....	730.0	2.44	2.75	5.19	Kaeleku
Niulii	20	20.3	K,9RM54	18x42(6),18x42(3)	....	254.0	5.2	.04	....	16.5	....	65.3	$4\frac{1}{2}$	114	..	..	....	....	....	....	30.2	....	63.5	....	90.1	....	62	151	....	....	195	41.4	64.4	25.8	24.3	10.5	10.9	36.3	35.2	48.0	....	72.0	....	....	378.0	1.83	3.67	5.50	Niulii
Waimea	20	20.4	2RC42,12RM42	18x42(8),16x42(6)	....	254.0	3.8	....	....	20.4	....	77.3	5	125	..	..	....	....	....	....	28.5	....	91.1	....	67.5	....	48	....	....	195	49.5	44.3	26.5	19.5	15.5	10.0	42.0	29.5	24.5	....	....	84.4	.23	....	1.83	3.21	5.04	Waimea

[1] These standards are approximately only as requirements at individual factories vary within a wide range.
[2] Two tandems.
[3] Second tandem—K,2RC72,S72,9RM72.
[4] Second tandem engines—16 x 36(2), 28 x 60(9).
[5] Boiler data from Bureau of Boiler Inspection.
[6] Hearth area.
[7] Does not include one oil fired boiler, 4,936 sq. ft. h. s.
[8] Divided clarification.
[9] Dorr.
[10] Does not include 1,337 sq. ft. area used for refining operations.

v Vapor used to boil massecuite.
v_1 Vapor from first cell used for heating juice.
v_2 Vapor from second cell used for heating juice.
v_3 Vapor from third cell used for heating juice.
v_4 Vapor from fourth cell used for heating juice.
[11] One set evaporators operated as quintuple effect.
[12] Operated as a quintuple effect.
[13] Includes one pan of 2,276 sq. ft. h. s. and 1,200 cu. ft. for refining operations.
[14] Supplemented by 2 jet condensers.
[15] Includes 167.55 sq. ft. screen area for refined sugar.